THURSDAY, NOVEMBER 12, 1914.

THE PLACE OF SCIENCE IN INDUSTRY.

AN interesting article, by Mr. W. H. Dawson, appears in the November number of the *Fortnightly Review*, under the heading "The Campaign against German Trade." It is there given as the opinion of one of "the six best known industrial leaders of Germany" that "England's days as an industrial country are over. Your industry will pass more and more into the hands of the younger nations, and you will become simply a trading country." The author of the article goes on to point out that the lesson of Germany's success will not be learned "if we refuse to grasp the fact that its people have brought to industrial and trading pursuits just the same habits of method, thoroughness, concentration, and seriousness which mark them in other departments of life." He attributes the success largely to the co-operation between science and industry which prevails in Germany. This cannot be denied; but a further reason for Germany's rivalry, so far as it is successful, is afforded by a quotation from a speech made in July, 1912, by the Prussian Minister of Commerce; it is that the desire of manufacturers is, without exception, that the import duties on competitive articles may be kept as high as possible, and the foreign duties on articles exported from Germany as low as possible. It is also emphasised by the writer of the article that German employers have never had to encounter systematic opposition on the part of the workers, as has so often been the case in this country. Again, the German cultivates methods of distribution much more sedulously than does the Englishman; he never forgets that he exists for his customers; and the larger firms, or combinations of them, keep highly paid agents in every important market. The Germans are also greatly aided by their banks, which advance money on the security of orders.

Mr. Dawson does not believe that changes in fiscal regulations alone would put the British manufacturers in the same favourable position as the German, although he does not deny the advantages of a protective tariff. British trade must be supported by foundations of brains, science, and education, if it is to succeed.

While the truth of the general scope of the article, of which an abstract has been given, cannot be denied, it appears doubtful whether British manufacturers would care to adopt all the methods of their competitors. The colour trade, to take an example, has been secured for Germany, not entirely by the training of the chemists and operatives, but by what the Germans somewhat indefinitely call "Kultur"—careful organisation. First, the management consists, not in a board of well-meaning elderly gentlemen with a works-manager in their employment, but in a board of specialists, whose business in life is to manage the factory, financially, chemically, and as engineers, and who are very highly paid for their services. Second, these gentlemen and a special staff are continuously on the look-out for any scientific discovery or invention (generally made in countries other than Germany) which can prove of advantage to their business. Third, a very large staff of men, trained in universities or in technical schools, is turned on to the problem of making such a discovery commercial, whether by securing cheap raw material, cheapening the process of manufacture, or creating a public demand for the article to be manufactured. Fourth, a legal staff is maintained, whose business it is to protect by patent all improvements, however apparently trivial, and to describe them so vaguely as to conceal them from their competitors; also to advise on means to crush competitors by expensive legal actions. Fifth, such companies are so powerful, that they can influence the central Government to protect all new developments, whether by imposing duties on articles which might possibly compete, by extending bounties to all exported products, or by securing advantages in freights to the coast, and in shipping the goods abroad. These gentlemen in some cases (not in all) have also to advise whether piracy is likely to be successful; whether it may not be possible, by infringing a patent, so to saddle an opponent with legal expenses as to break his competition. Sixth and last, agencies are maintained all over the world whereby the article is introduced to the notice of foreign purchasers, and an extensive credit system is encouraged.

Trade, in fact, is regarded in Germany as a war, in which all means of conquest are permissible. We are at present discovering, in the military operations of the Germans, the precise equivalent in war of their operations in trade. It remains to be seen whether we shall care to do business with them when a state of industry succeeds a state of war. If we are to conquer, we have the alternatives; to copy their methods; or to refuse to deal with them. Perhaps these

are not exclusive; for there are many things in their methods which we might with advantage copy; and we could perhaps boycott trade conducted according to plans which we consider dishonourable or underhand. Time alone will show. But this is a fitting opportunity to consider our position; and by organisation, by co-operation among our manufacturers rather than by competition between them, and by education in science of our directors and employees, we might do much to forestall the attack which will undoubtedly again be made on our commercial position, if, at the end of the war, any prospect of recuperation is left to Germany. WILLIAM RAMSAY.

SCIENCE THE HANDMAID OF ART.

The Pigments and Mediums of the Old Masters. By Prof. A. P. Laurie. Pp. xiv + 192 + xxxiv plates. (London: Macmillan and Co., Ltd., 1913.) Price 8*s*. 6*d*. net.

THE information given in this book shows that the scientific man has come to the aid of the art expert in his endeavour to determine the period and the authorship of paintings of disputed origin. The author's previous works on "Greek and Roman Methods of Painting" and on "Materials of the Painter's Craft" indicate in what degree historical and literary research coupled with technical knowledge can be relied upon as guides in such an inquiry.

The present volume shows to what extent exact experimental investigation can be utilised to assist in this matter. The methods available are based upon an examination of the physical and chemical properties of the pigments and mediums used, and a microscopical examination of the nature of the brush work of the picture. The latter has given very interesting results, and shows that great individuality is found in the work of different artists.

The method recommended by the author for a critical examination of the brush work is to make a photomicrographic reproduction of a selected portion of the picture under a magnification of about three diameters.

The author is gradually accumulating a series of such photomicrographs, of well-authenticated pictures, and these will certainly be a valuable aid in the detection of forgeries, copies, etc. Some striking plates are shown in the book illustrating the use of such brush work enlargements, and the value of the method is well seen by a comparison of plates vi. and vii.—the former from a picture by J. A. Watteau and the latter from a copy by a good modern artist.

In addition to their use for the purpose of identification, it appears probable that such photomicrographs might be of much value for instructional purposes, as indicating the methods adopted by noted artists in developing their effects.

The first ten chapters of the book deal with the examination of the pigments and mediums. The physical character of the pigments, such as coarseness of particles, simple or mixed character, etc., may be frequently determined *in situ* under a magnification of about 100 diameters; but the removal of a minute fragment of pigment for more detailed examination is usually desirable. This may be done by making use of a microscopic gouge about a millimetre in diameter, or a complete section through the picture may be obtained by using a hypodermic needle. Full instructions are given for the transference and examination of the fragments of pigment, all tests, of course, being applied under the microscope.

The identification of the pigments and medium used in well authenticated pictures, coupled with historical information regarding the nature of the pigments in use at certain periods, makes it possible approximately to date many pictures, and the knowledge of the particular palette used by an artist, together with an examination of his brushwork, greatly facilitates a judgment in cases of doubtful authenticity.

The book is thus of much interest, not only to dealer and collector, but to the artist and historian. It is obvious, however, that the new methods of examination should be applied to valuable works of art only by such special experts as Prof. Laurie, and there is some slight danger involved in the publication of methods of sampling "old masters," even when the sample is to be taken with a hypodermic needle.

WALTER M. GARDNER.

PUBLIC HEALTH.

(1) *Preliminary Report on the Treatment of Pulmonary Tuberculosis with Tuberculin.* By Dr. Noel D. Bardswell. With a Prefatory Note by Prof. Karl Pearson. Pp. xxi + 141. (London: H. K. Lewis, 1914.) Price 6*s*. net.

(2) *Cambridge Public Health Series. Isolation Hospitals.* By Dr. H. Franklin Parsons. Pp. xiv + 275. (Cambridge: University Press, 1914.) Price 12*s*. 6*d*. net.

(3) *The Bacteriological Examination of Food and Water.* By Dr. William G. Savage. Pp. x + 173. (Cambridge: University Press, 1914.) Price 7*s*. 6*d*. net.

(1) TREATMENT of tuberculosis, and in particular pulmonary tuberculosis (phthisis or consumption), with tuberculin is undoubtedly tending to increase in England, and a number of

sanitary authorities have established "tuberculin dispensaries," where it may be applied to the poorer population under adequate medical supervision. On the other hand many Continental authorities view tuberculin treatment with considerable distrust. The appearance of Dr. Bardswell's report is therefore opportune, and we could have hoped that experience in the King Edward VII. sanatorium might have settled the real value or otherwise of tuberculin in the treatment of consumption. Some of the data obtained seem to be in favour of it, but Prof. Karl Pearson has examined the statistical data, and concludes that they do not show "that obvious and marked advantage of tuberculin treatment which would raise it at once above all suspicion of showing what advantage it does show, owing to selection of patients. Correction for selection may show it with a slight credit or an actual debit. . . . When all selected cases are treated as at present, we shall have no suitable control to determine whether the treatment has any real value, unless indeed we again leave it off." We notice that X-ray photographs do not appear to be a routine method of examination at this sanatorium, which is surprising, and Spengler's picrin method for staining the tubercle bacillus might be adopted with advantage.

(2) This book on isolation hospitals must be regarded as an authoritative one, as Dr. Parsons was a recognised authority on the subject. The past tense is used because the author did not live to see the work through the press, and its correction and completion was undertaken by Dr. Bruce Low. The book contains far more than its title indicates, as it really deals with the whole question of isolation for the preventive treatment of infective diseases. Thus in addition to isolation hospitals, the subjects of home isolation, eucalyptus treatment, and the law in relation to infectious diseases are fully discussed. Under isolation hospitals, the subjects of area, site, design, staffing, removal and discharge of patients, and cost are dealt with. Additional chapters are devoted to the hospital system of the Metropolitan Asylums Board and sanatoria for tuberculosis. A number of plans with descriptions of existing isolation hospitals complete the work, which should be of the greatest value to public health students and authorities.

(3) Dr. Savage has brought together into one volume a mass of valuable data relating to the bacteriology of foods, water, air, soil, and sewage, together with a description of the methods employed for examining them bacteriologically. He himself has contributed much to the subject, and is therefore able to discuss critically the value of the various methods employed, and of the data obtained therefrom. In a final chapter the determination of antiseptic and germicidal power is described, and the composition of the media employed is given in an appendix. The book is a very useful addition to the Cambridge Public Health Series, which is now being issued under the editorship of Dr. Graham Smith and Mr. Purvis. R. T. HEWLETT.

LIGHT AND ITS ACTIONS.

(1) *Photo-Chemistry.* By Dr. S. E. Sheppard. Pp. x+461. (London: Longmans, Green and Co., 1914.) Price 12*s.* 6*d.*

(2) *Photo-Electricity.* By Prof. A. Ll. Hughes. Pp. viii+144. (Cambridge: University Press, 1914.) Price 6*s.* net.

THE interest of scientific workers in the chemical and physical changes brought about by light is shown by the number of works recently published bearing on this subject. The importance of investigations on the action of light can scarcely be over-estimated, seeing that human life is dependent on "that branch of applied photochemistry which is termed agriculture."

(1) Dr. Sheppard gives an account of the principal facts relating to photo-chemistry, and discusses the present state of the theory of the subject. The book is very unequal. So far as the facts are concerned, the description is generally clear, but in the more theoretical portions the author frequently runs amok and indulges in quasi-philosophical discussions which do not add to the lucidity of his argument. The work, unfortunately, justifies the complaints made against the literary style of many men of science. Thus on p. 229 we have a sentence containing fifteen lines, and on the following page a sentence of fourteen lines. The author has a predilection for the use of foreign words and for the introduction into his subject of new terms which are often only vaguely defined, if defined at all. We do not recognise "temps" as an English word, and do not regard *mass* and *measure* as interchangeable terms, though the author speaks of "Radiant Energy in Absolute Mass."

In spite of many faults of presentation the volume will be found useful, as it contains a large amount of matter not available in other English works. The first half of the book deals with the physical side of the subject, and includes chapters on the measurement of light quantities, the energetics of radiation, and the absorption of light. Actual light-sources are also considered, special attention being given to the light of the sun, either in its direct form or as diffused daylight. The mercury vapour lamp scarcely receives ade-

quate recognition. The second part of the book deals principally with the chemical changes due to different forms of radiation. The author summarises his views by saying: "The conception that in photo-chemical change singular intermediate complex ions, or, specifically speaking, veritable latent light-images, are formed, appears the most promising."

(2) The account of photo-electric phenomena given by Dr. Hughes is lucid and concise. The photo-electric effect is regarded as a form of ionisation by light. Most of our information as to such ionisation has been derived from a study of the action in the case of solids and liquids, owing to the fact that in the case of gases ionisation is only brought about by light of extremely short wave-lengths. The aim of the author appears to have been to give a comprehensive view of the present position of the subject. In this he has been successful, though the result is perhaps to mar the historical setting and to deny adequate recognition to some of the earlier workers. Thus the work of Hallwachs and his pupils on the influence of contact potential on photo-electric phenomena is not referred to. The "energy law" which is emphasised in this book was established mainly by the experiments of the author and of Richardson and Compton. It expresses the fact that the maximum emission energy of a photo-electron is a linear function of the frequency of the light. This is in accordance with the quantum theory of radiation developed by Planck and Einstein, and first applied by W. Wien (whose name is not mentioned) in connection with Röntgen rays in 1907.

Both volumes contain a subject index and an index of authors. In the case of the latter volume the index of authors is far from complete.

PHILOSOPHY.

(1) *A Theory of Civilisation.* By S. O. G. Douglas. Pp. 246. (London and Leipzig: T. Fisher Unwin, 1914.) Price 5*s.* net.

(2) *Our Knowledge of the External World, as a field for Scientific Method in Philosophy.* By B. Russell. Pp. vii+245. (London and Chicago: The Open Court Publishing Co., 1914.) Price 7*s.* 6*d.* net.

(1) A READABLE and well-informed treatment of civilisation viewed as the outcome of religious belief. The various "psychic illusions" are considered—Olympianism, Orphism, Christianity, Islam, Buddhism, the ancient religion of Peru, etc.—and it is argued that each religion has elements which tend to an advance in civilisation, these elements being always irrational, for the rational and critical and selfish elements furnish no driving power except as to the individual's own well-being. In course of time disillusionment comes about; the beliefs are gradually abandoned as the intellectual powers—which have grown with the civilisation—assert themselves critically, and there is then a slide down until civilisation and the general intelligence reach such a level of degeneracy that another "psychic illusion" becomes possible. The process then repeats itself; though the author apparently thinks that the crest of each civilisation-wave is, on the whole, higher than the last, the "spirit of evolution" selecting for each successive illusion that which will yield improved results. The interesting question naturally arises as to whether, after Christianity, we shall manage to get along without illusions at all, or whether a new illusion will impose itself, as before. The author inclines to the latter opinion, but wisely refrains from detailed prophecy.

(2) This volume contains Mr. Russell's Lowell Lectures, delivered in Boston last March and April. They deal with the various idealisms—Platonic, Berkeleyan, Bradleyan, etc.—as the title implies, but there is also some acute criticism of Bergson's intuitionism, and a full analysis of the old problems of Achilles and the tortoise, and the impossibility of the moving arrow's motion. The author maintains the fresh and brilliant yet easy style which always makes his writings a pleasure to read, and though, as he says, philosophy in becoming more scientific inevitably becomes less humanly interesting, it is likely to retain devotees as long as it has such exponents as Mr. Russell.

The book is, of course, mainly logical, and the modern position is maintained. "The trivial nonsense embodied in this [Aristotelian] tradition is still set in examinations, and defended by eminent authorities as an excellent 'propædeutic,' *i.e.* a training in those habits of solemn humbug which are so great a help in later life" (p. 33).

"The old logic put thought in fetters, while the new logic gives it wings. It has, in my opinion, introduced the same kind of advance into philosophy as Galileo introduced into physics, making it possible at last to see what kinds of problems may be capable of solution, and what kinds must be abandoned as beyond human powers. And where a solution appears possible, the new logic provides a method which enables us to obtain results that do not merely embody personal idiosyncrasies, but must command the assent of all who are competent to form an opinion" (p. 59).

BOTANY AND GARDENING.

(1) *The Standard Cyclopedia of Horticulture.* By L. H. Bailey. Vol. i, A. B. Pp. xx+602 +plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) 25*s.* net.

(2) *Plants and their Uses.* An Introduction to Botany. By F. S. Sargent. Pp. x+610. (London: Constable and Co., Ltd., 1914.) 5*s.* net.

(3) *My Garden in Summer.* By E. A. Bowles. Pp. viii+316+plates. (London and Edinburgh: S. C. and E. C. Jack, 1914.) 5*s.* net.

(4) *Some Desert Flowers collected near Cairo.* By Grace M. Crowfoot. Pp. 50 (35 plates). (Cairo: F. Diemer, n.d.) 6*s.*

(5) *Flower Favourites: Their Legends, Symbolism and Significance.* By Lizzie Deas. 2nd edition. Pp. viii+229. (London: Jarrold and Sons, n.d.). 3*s.* 6*d.* net.

(1) THE Standard Cyclopedia of Horticulture, by Mr. Bailey is indeed a monumental work—we wish that its weight did not add force to the use of our adjective. Only the first volume is before us, but from this it will be seen how comprehensive and useful the completed work will be. It is written from the point of view of the American horticulturist and in some respects is therefore not always suitable for the English reader, but so much is of real value to all engaged in the science that its decidedly American point of view does not detract seriously from its value to the British or Colonial reader.

An admirable synopsis of the plant kingdom extending over 78 pages, is followed by a very useful key to the families and genera of plants. Then comes an exhaustive list of plant names in Latin with their English equivalents, which should be found of great service. Our only quarrel with this portion is the division of the Latin words, as an aid to their pronunciation, but entirely irrespective of their formation. Surely the position of the accent would have been sufficient. How unpleasant and misleading are the following: *multij ugus, oxyphýl lus, pentán drus, dichót omus,* and the like!

There is also a good glossary of terms.

The articles on the plants themselves are well written, and in addition there is a mass of general botanical information. Under the headings "Arboretum" and "Arboriculture," for instance, there is a disquisition of some 35 pages in double column, giving quite an exhaustive treatise on the subject. Plant weeding receives equally useful treatment. Some articles like that on flower arrangement might well have been omitted, but on the whole the book is a very useful publication, though had it been prepared for English readers they would probably have preferred a volume less discursive and more in the style of Nicholson's Dictionary.

(2) An old friend in a new dress presents certain attractions if the dress is suitable, but we object to a rather thin attempt to veil the usual form of teaching under a dull and useless cloak. Mr. Sargent sets out with the idea that botany can be best taught by approaching it from the economic side, and finds himself in difficulties because with each plant or group of plants he is in the midst of his subject before he has been able to deal with the elements. The earlier chapters which treat of plant foods, vegetables, fruits, spices, condiments, drugs, poisonous plants, etc., are very well done in their way, but the method necessarily results in a jumbling together of a heterogeneous collection of unrelated plants and masses of useful information set out in a dull and unattractive manner.

Then follows an account of certain natural orders, some treated diffusely, others very shortly, and a remarkable set of formulæ of seed plants which are fearsome to behold. We venture to think that he who seeks to derive a love of botany from Mr. Sargent's book will be in the unfortunate position of the blind man looking for the black hat.

(3) Why is it that so many people who excel in one sphere of life attempt to display their powers in directions in which they are quite unsuited? In the case of those who make books there are many sad examples of people who, however much they excel in their own particular line, are quite incapable of expressing with a pen what they can ordinarily impart with ease and grace by word of mouth. Among books dealing with gardens and gardening more than one case could be cited, but perhaps one of the most unfortunate efforts is that by Mr. Bowles in his attempt to describe his own beautiful garden. To those whose privilege it is to know the author, and who can appreciate his rare and intimate knowledge of plants and their cultural requirements, it is a matter of pain to find him in print a very Mr. Hyde by comparison.

If only he could have begun his chapters in the middle, and so obviated the terrible stumbling-block of a grandiloquent opening, things might have been better, but even in the middle of a chapter it is a severe trial to come across such a passage as this:

"Two out of our three bushes of *Buddleia globosa* reside close by where we now stand, and are providing free drinks for the bees and a de-

licious scent of heather-honey for my nose if I apply it to the golden cowslip-balls in miniature, after I have shaken off the bees, which might not behave kindly to my proboscis, mistaking it for a rival to their own in the honey-gathering trade."

This, alas! is typical of many others which give a painful stab in the middle of chapters containing a great deal of interesting and valuable information.

The book is illustrated by some very fair photographic reproductions, but the coloured plates are miserable. The sad part is that Mr. Bowles has the knowledge that others seek to acquire, but an evil spirit appears to haunt him when he takes his pen to write.

The book contains a great deal of very valuable and interesting information, but the shock to the literary sensibilities of those who seek to extract the gold is almost too severe.

(4) The pictures of desert flowers will be very useful to travellers interested in the desert flora of Egypt. The photographs, especially when taken in the field, are good, and the introductory twelve pages are well written. We hope Miss Crowfoot will be rewarded by a ready sale for her book, and induced thereby to publish a further volume of pictures of the flowers of the desert. Should this be feasible a plate giving a detailed study of the flowers, fruits, and leaves of each plant, would be a useful addition to accompany the plate showing the habit of the plant in its natural conditions.

(5) "Flower Favourites" is a very pretty little book, a storehouse of quaint legend and myth relating to some forty-eight well-known flowers. Among them are such familiar plants as the rose, cowslip, speedwell, leek, and hyacinth, and in all cases numerous quotations from the poets are given which refer to the particular flowers. It is a book for which lovers of flowers will be grateful, since it has been compiled with great care, and shows that the author has a very extensive knowledge of the ancient and modern literature of plant lore. It is essentially a book to be appreciated by those whose vision penetrates beneath the surface.

> "Earth's crammed with heaven
> And every common bush afire with God:
> But only he who sees takes off his shoes:
> The rest sit round and pluck the black berries."

OUR BOOKSHELF.

Kinetische Stereochemie der Kohlenstoffverbindungen. By Dr. A. von Weinberg. Pp. viii + 107. (Braunschweig: F. Vieweg und Sohn, 1914.) Price 3 marks.

IT would be difficult within the compass of a short notice to develop the highly speculative conception which underlies what the author terms "kinetische stereochemie." He claims that it will eliminate the vague notions which hover round the theory of valency, and have rendered it necessary to qualify this attribute by the use of "partial" valencies, broken valencies, distributed valencies, and valency electrons.

Dr. von Weinberg has attempted to prove that chemical changes are determined by atomic motions; that these motions are rotatory and vibratory, and are closely linked to the phenomena of heat of combustion and molecular refraction. He considers that by means of this conception it is possible to solve a variety of unsolved problems, such as the structure of benzene, the phenomenon of dynamic isomerism, the asymmetric carbon, optical activity and colour.

He lays down the proposition that in all states of aggregation the atom has motion, and that the energy content of these atomic motions in organic compounds may be determined by the atomic volumes, which in turn can be estimated as heat of combustion and atomic refractivity. He further assumes that singly-bound atoms rotate or oscillate round an axis, and that doubly- and trebly-linked atoms undergo a vibratory movement. The difference in the heat of combustion of an atom when combined in an organic compound and when free as an elementary molecule is not a question of a change in chemical affinity, but of the increase or decrease in atomic motion in the two states. In the same way increase or decrease of atomic volume, as determined by the motion (rotatory or vibratory) of the combined atom, is manifested by the density of the liquid substance, *i.e.*, its refractivity. These two ideas are developed conjointly at some length, and a considerable mass of data is introduced to support the theory. We think that some of the statements are open to criticism, such, for example, as making one kind of atom in a compound responsible for the whole difference in the heat of combustion, and consequently in atomic motion and so forth. Whether these speculations, for they are pure speculations, will serve to stimulate further experimental inquiry is somewhat doubtful; but the theory is bold and suggestive, and the pamphlet is well worth perusal. J. B. C.

The Essence of Astronomy: Things Everyone Should Know about the Sun, Moon, and Stars. By E. W. Price. Pp. xiv + 207. (New York and London: G. P. Putnam's Sons, 1914.) Price 10*s.* 6*d.* net.

THE title "The Essence of Astronomy" gives a good idea of the lines on which this book has been written. The book does not pretend to be a treatise, and it deals only with the main, well-authenticated facts in a popular manner. All technical terms, mathematical formulæ, and symbols have been omitted in the text, but the last-mentioned are given on a separate page at the end of the volume.

Those who wish to read a simple and brief account of the main facts about the sun, planets, asteroids, comets, and stars (normal and abnormal) cannot do better than peruse this book. A general idea of the universe will be easily obtained, and some notion of the vast subject of astronomy will be gained. The illustrations are reproduced from some of the finest photographs ever taken, and they are well distributed and chosen. A brief bibliography of books more or less popular is given at the end; also a chronology of the main events of astronomy from very early times to 1908. With regard to the latter the author seems to think that such a table is unique or "what the compiler has never happened to see before." To take only one instance, he has evidently never seen Miss Clerke's admirable "History of Astronomy during the Nineteenth Century," at the end of which is a chronological table stating the main astronomical advances from 1774 to 1893.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fizeau's Experiment and the Principle of Relativity.

MR. CUNNINGHAM seems determined that the principle of relativity shall assert supremacy as regards the Fizeau effect on the velocity of light, arising from motion of the transmitting medium. This is a first-order effect, while the principle of relativity was invented to account for the second order. Up to the first order the affairs of moving media hang entirely on the ascertained fundamental relations of electrodynamics; and any type of relativity which does not agree with the formula thence deduced must, if substantiated, upset our whole system of ideas.

As regards the arguments adduced: (1) is of course a slip of the pen—he is thinking of steady viscous flow in a pipe, whereas the standard measures for ordinary turbulent flow are in general agreement with the values quoted from the experiment; while as regards (2), it seems certain that the experimenters must have had before them the effect of variation of velocity across the section of the pipe, which would curve the fronts of the waves and thus broaden the interference bands, but not much if only the central part of the pipe, in which the velocity varies but slightly, is employed. The shift at the centre of the band-system would depend on the axial velocity only. JOSEPH LARMOR.

Cambridge, November 2.

THERE was no intention in the letter to which Sir Joseph Larmor refers (NATURE, October 29, p. 226) of suggesting that the principle of relativity and the fundamental relations of electro-dynamics were at variance with respect to this matter. Certainly I have always taken them to be completely at one. But it has been raised in several quarters as an objection to both points of view that the extremely careful experiment of Michelson and Morley was not in complete agreement with theory. They found the convection coefficient for water to be $0{\cdot}434 \pm 0{\cdot}02$, while theory (taking account of dispersion according to Lorentz's formula) gives 0·451, which is very near the limit of possible error.

Sir Joseph Larmor makes it clear that the suggestions which I made as to the possible origin of the discrepancy are untenable, and, I understand, feels that it must lie in the inherent difficulties of the experiment. One of these is the determination of the axial velocity in terms of the mean. The experimental device could not be expected, I think, to give a result correct to one or two per cent., inasmuch as the pressure gradient actually measured is partly the normal pressure gradient of the undisturbed flow, and partly that due to the disturbance produced by the insertion of the gauge-tubes.

But, as a matter of fact, the discrepancy is not so great as has been thought. A recalculation from the figures and formulæ of Michelson and Morley, which Sir Joseph Larmor has now checked for me, gives for the experimental value of the coefficient 0·442, with their estimated possible error of $\pm 0{\cdot}02$. Thus the discrepancy (0·009) with the value given by Lorentz's formula (including dispersion) proves to be less than half the possible error.

E. CUNNINGHAM.

Wireless Signalling for Shipping in War Time.

THE advantage which wireless telegraphy has been in enabling the whereabouts of vessels at sea to be known from day to day, is now in abeyance, I believe, on account of the war, because of the messages being liable to be read by the enemy.

But if a system of signalling false latitudes and longitudes by a code prearranged by the owners, different for each craft, and variable from day to day, easy and simple to translate by reference to the copy kept, then wireless signalling could go on as freely as before, without danger of the code being captured by the capture of any craft.

To illustrate the method of this, let us suppose a firm of owners have two ships, the *Ariadne* and *Ocean Bird*. A list of dates has been given to each captain with instructions to falsify positions on the respective dates (London time) with additions and subtractions as found in the list in opposition to the dates, thus :—

SHIP "ARIADNE."

	Lat.	Long.
Nov. 1	+14°	−21°
2	−16°	+15°
3	+30°	+20°
	etc.	

SHIP "OCEAN BIRD."

	Lat.	Long.
Nov. 1	−18°	+24°
2	−16°	−21°
3	+18°	+15°
	etc.	

The owners of these ships could interpret the wireless messages received through the exchange, and the Admiralty be quickly notified of a disappearance with approximate latitude and longitude.

A. BOWMAN.

144 Well Street, Hackney.

NOTES ON STELLAR CLASSIFICATION.

IN all my early work at Kensington (1887) on the classification of stars according to their spectra, the best basis for a classification was chiefly considered. The data available were the chemical facts obtained by a detailed inquiry into the chemical origins of the various lines and flutings, using higher dispersion and more laboratory work than were employed in other observatories.

The first and most important result obtained was that it was found necessary to divide the stars into two groups, one set increasing their temperatures while in the other the temperature was running down.

This, indeed, added a *physical* difference to the chemical ones, and there was another, for on the meteoritic hypothesis the stars getting hotter were sparse swarms of meteorites being vaporised, while those getting colder were rapidly condensing into solid bodies.

These were fundamental changes of front. Up to that time only a line of decreasing temperature had been considered. Passing over the earlier classification of Rutherfurd (1863), which was only modified by Secchi (1867), though by those ignorant of the subject he is credited with the origination of it, I may mention that in 1873 I referred to the question of temperature in a Bakerian Lecture,[1] and in 1874 Vogel brought out a considerable classification. This was also based upon a line of descending temperatures. On this classification I wrote in another Bakerian Lecture (1882)[2]:—

"The idea which underlies the classification is that a star of Class I. on cooling becomes a star of Class II., and that a star of Class II. has as it were a choice before it of passing to Class III*a*. or Class III*b*. Thus under certain conditions its spectrum will take on the appearance of Secchi's third type, Class III*a*. (Vogel); in certain other conditions it will take on the appearance of Secchi's fourth type, Class III*b*. (Vogel). There is now, however, no doubt whatever that Secchi's Class III., represents stars in which the temperature is increasing, and with conditions not unlike those of the nebulæ—that is to say, the meteorites are discrete, and are on their way to form bodies of Class II. and Class I. by the ultimate vaporisation of all their meteoric constituents. There is also no doubt that the stars included in Class III*b*. have had their day; and that their temperature has been running down, until owing to reduction of temperature they are on the verge of invisibility brought about by the enormous absorption of carbon in their atmospheres."

"Pechüle was the first to object to Vogel's classification, mainly on the ground that Secchi's types III. and IV. had been improperly brought together; and my work has shown how very just his objection was, and how clear-sighted was his view as to the true position of stars of Class III*b*."

Prof. Keeler wrote in 1894[3] "Lockyer's system of stellar classification provides for both an ascending and a descending branch of the temperature curve, and in this respect it certainly has advantages over other systems which claim to have a rational basis."

Prof. Frost[4] thus alludes to it: "Many spectroscopists are unwilling to admit that the only course of stellar development is along a line of descending temperature." He does not name the "many spectroscopists," but he adds: "The further question may be raised—Is it not possible that a celestial body, after it has reached the condition in which we may define it as a star, may twice be red and exhibit a spectra of the third type, once in its youth and again in its old age?"

In my papers are many statements giving the answer to this question, years before Prof. Frost put it.

In the Bakerian Lecture (1888) I published a temperature curve with ascending and descending arms, along which stars could be arranged according to their swarm- and condensing-conditions and their temperature as revealed by the spectra. On it were rearranged stars as classified by Vogel and stars with bright lines and nebulæ. Another curve was given in the catalogue of 470 of the brighter stars which I afterwards published in 1902, in which I classified stars only, giving to each group a distinctive name.

Of the stellar spectra used, some had been photographed at the Solar Physics Observatory and others by Mr. McClean at the Cape and Tunbridge Wells.

A few years after the publication of Vogel's memoir the work of classification was taken up at Harvard. The first one adopted was an alphabetical, from A and B onwards in one line. This we may mark as H.1.

At about the same time (1888) that I published my temperature curve at Kensington, the classification of northern stellar spectra in special new groups was being carried on at Harvard by Miss Maury as part of the Henry Draper Memorial. The classification was on one line of temperature in groups numbered from i to xxii. (H.2.).

But Miss Maury did not content herself with the group classification; over and above her twenty-two groups of spectra she gave us three main divisions of stars depending upon the characteristics of the individual lines. Here we find a physical touch superadded. In Division *a* were included lines narrow and clear, in *b* lines relatively wide and hazy, and in *c*, among other conditions, unusually intense metallic but not solar lines. I found these divisions of the utmost value to me when I was preparing my classification.

The Southern stars were undertaken by Miss

[1] Phil. Trans., vol. clxiv., p. 292.
[2] Proc. R.S., vol. xliv., p. 1.
[3] "Ast. and Ast. Phys." 1894, p. 60.
[4] "Astronomical Spectroscopy," p. 318. 1894.

Cannon, who employed H.1., but some groups were discarded and stars between F and G, for instance, were classed as F5G or F8G. We may mark this as H.3.

The work of Harvard is monumental; tens of thousands of stars have been classified so far as small dispersion can do it, but obviously a straight line, instead of a curve of ascending and descending temperatures, has been followed in the three classifications used one after the other, and in all, if my views are sound, stars of vastly different constitution, sparse swarms and condensed stars, are called by the same name.

A subject of great regret is that, as this is the only large scale classification extant, it is now being used to deal with questions in which it is vital that stars differing in physical constitution shall *not* be classed together; in which such a mixing invalidates the conclusions arrived at in such inquiries.

In the last authoritative book published on these matters Prof. Eddington writes:—"From time to time there are indications that the Draper classification has not succeeded in separating the stars into really homogeneous groups. According to Sir Norman Lockyer there are stars of ascending temperature and of descending temperature in practically every group; so that, for example, the stars enumerated under K are a mixture of two classes, one in a very early, the other in a late stage of evolution."

Prof. Russell, a diligent worker on the characteristics and spectra of stars, has written as follows:—

"I have endeavoured . . . to set before you the present state of knowledge concerning the real brightness, masses, densities, temperatures and surface brightness of the stars, and to sketch the theory of stellar evolution to which the study of these things has led me. This theory is inconsistent with the generally accepted view. Its fundamental principle is identical with that of Lockyer's classification."

Prof. Russell objects to the principles on which I have placed stars in the different groups but that is another, and less important, story, which will be dealt with later.

Prof. Ludendorff[5] has recently provided a case in point; he has discussed Prof. Campbell's results on radial velocities and stellar types based upon the Harvard classification. Difficulties were met with. Dr. Ludendorff points out that these are avoided and that a distinct differentiation of the velocities is obtained if the stars are arranged in the order of ascending and descending temperatures. Of the sixty-three stars selected by Campbell, eighteen are contained in my classification; of these ten are on the ascending arm, and the velocities are all +; the remaining eight are on the descending arm, and the velocities, with one exception, are −. The exception is a star very near the top of the curve.

In arranging the programme of work for the Hill Observatory, the first place has been assigned to the continuation of the catalogue of the bright stars classified on my hypothesis (of two groups of stars, one increasing, the other decreasing their temperature), so that the 470 we already have may be as soon as possible increased to 1000, which will give us a broader base.

I have also occupied some time in considering stars varying from the normal condition dealt with in my published classification. These are:—

Stars with bright lines.
Variable stars with bright lines.
Variable stars without bright lines.
Double stars without bright lines.

The object of my inquiry was to ascertain whether further generalisations were suggested as regards the arm of the curve on which these stars should be most probably found, irrespective of their chemical constitution on which my classification was founded.

This further inquiry was based on my hypothesis[6] that the bright lines in variable stars were due to collisions between meteor swarms. Düner has shown that in Class III*a* (Antarian), of 297 stars 44 were variables, that is, 1 in 7. I found[7] in 1894 that in β Lyræ two bodies resembling Rigel and Bellatrix were involved. This lands us in the Crucian stage, nearly at the top of the ascending arm.

When we deal with variable stars without bright lines (eclipsing variables), the light curves show that we are dealing no longer with swarms, but with bodies with discs and therefore with photospheres, and therefore again approaching the solar condition. Now the best known variable of this class is Algol, the type star of one of my groups nearly at the top of the descending arm, nearly on a level with the Crucian group on the other.

From these facts we learn that bright line variables with the Harvard Classification, B. A. F. K. M. should be stars increasing their temperature, while eclipsing variables marked B. A. F. K. N. should be decreasing their temperature.

The result of the preliminary inquiries so far has been very encouraging.

Stars with bright lines have been found in species represented on the ascending arm of the curve, and none on the descending side.

All variable stars with bright lines so far studied belong to the ascending side, eclipsing stars which do not show bright lines to the descending arm.

A great majority of the double stars without bright lines so far considered belong to the descending arm.

Details on all these points will be given when the research is further advanced.

It may be remarked that the danger of using the Harvard classifications is not the same for all the groups.

The normal stars which differ most in their physical state are the Antarian (ascending) and the Piscian (descending). These are differentiated by the adjacent letters M and N (A and Z would have been better).

One of the finest memoirs which has ever been

[5] *Astronomische Nachrichten*, No. 4847, vol. cxc., p. 193.

[6] Proc. Roy. Soc., 1888, p. 80. [7] Proc. Roy. Soc., vol. xli., p. 278.

written on stellar spectra is that of Düner on the two types, III*a*. and III*b*. of Vogel's classification. And a study of it will show that no two groups of spectra differ more widely than these.

To secure simplicity I represented the two arms of the temperature curve of equal inclination, and to save space I used a narrow angle between them (although by all analogy the descending arm should fall less rapidly than the ascending one). The more the curve is flattened the less difference there will be in the physical conditions of stars on either side of the apex representing the highest temperature. These stars, therefore, will be difficult to classify, and even some of the conditions may vary in the Alnitamian, Crucian, and Achernian groups.

It is half-way up the two curves that the greatest confusion may arise if stars of the same name; (A, F, K) are treated as if their physical state were similar, α Cygni and Sirius, for instance, both A in the Harvard classification (H.3).

NORMAN LOCKYER.

(*To be continued.*)

THE SERVICE OF SCIENCE.

A FEW months ago public attention was being directed by articles and letters in the *Morning Post* to the inadequate remuneration and prospects of scientific workers, particularly those engaged in research. The subject is one to which many columns of NATURE have been devoted since the foundation of this journal in 1869, but it cannot be too widely discussed if any serious effort is to be made to secure improved conditions in the future. The present is not perhaps the most propitious moment to ask for increased endowment of science and encouragement of discovery, but there are points relating to the position of science which can be stated as appropriately now as at any time. Some of these matters are referred to in an article on "Science and the State" in the October number of *Science Progress*, and the whole subject is under consideration by a committee of the British Science Guild.

The article in *Science Progress* is in continuation of one which was published in the April number, and its purpose is to offer a programme of steps toward the betterment of science in Britain and elsewhere. It is shown that the emoluments of scientific men are much below what might reasonably be expected for exceptional attainments; and the claim is made that the State should offer special rewards or pensions to investigators whose researches have proved of decided national or public advantage without being profitable to themselves.

The unsatisfactory positions of many professors and lecturers in our universities and other institutions of higher education, is due largely to the management of the institutions by commercial men who like to see fine buildings but are unable to understand the use of most of the work carried on in them. It comes as a surprise to such men to be told that in scientific circles usefulness is rarely adopted as the standard of value; and that even if not a single practical result is reached by an investigation, the work is worth doing if it enlarges knowledge or increases our outlook upon the universe. This proposition, of course, leaves the practical man cold; yet it is all that science desires to offer in justification of its activities. While the discovery of truth remains its single aim, science is free to pursue inquiries in whatever direction it pleases; but when it permits itself to be dominated by the spirit of productive application it will become merely the galley-slave of short-sighted commerce. Almost all the investigations upon which modern industry has been built would have been crushed at the outset if immediate practical value had determined what work should be undertaken. Science brings back new seeds from the regions it explores, and they seem to be nothing but trivial curiosities to the people who look for profit from research, yet from these seeds come the mighty trees under which civilised man has his tent, while from the fruit he gains comfort and riches.

Industrial research is concerned, not with the discovery of truth, but with the production of something which will be of direct service to man and from which pecuniary profit may be secured: it is the province of the inventor rather than that of the man of science. Such research and that carried on with no ulterior motive are complementary to one another. Science has done its part when it has made a new discovery; constructive engineering renders good service when it shows how the discovery may be chained to the advancing chariot of industry. To foresee the possibilities of a discovery, to transform a laboratory experiment into the mechanical plant of a large works, or to apply it to the needs of ordinary life, require aptitudes not commonly possessed by the scientific investigator. The engineer usually has such practical purposes in mind; discoveries are to him things to be used and not ends in themselves, as they are to the man of science. He seeks not so much to know Nature as to circumvent her; and the research which he undertakes or organises has for its object the artificial preparation of substances which are naturally rare, the production of a new process or the improvement of an old, the design of machines which will increase his power over her, and of instruments which will enable him to laugh at limitations of time and space.

Research is necessary for these advances, but the spirit in which it is carried on is essentially different from that of the scientific worker. The engineer or the inventor first of all perceives a need and then endeavours to devise a means of meeting it. If he is of a scientific type of mind he will make an accurate analysis of the conditions to be fulfilled, and then design his machine or instrument to fulfil them; but the usual way is to find practically what will perform the required functions, and to leave experience or scientific knowledge to indicate how improvements may be effected.

Scientific research may thus be divided conveniently into two classes—one in which the motive is solely the desire to extend the boundaries of knowledge, while in the other the special purpose is to obtain results which have a direct bearing upon problems of manufacture and construction. Explorers on the ship of science go out to discover new lands; and their spirit is not the same as that which actuates the prospectors who follow them with the intention of making the lands profitable to themselves and others. Both these classes of pioneers have their proper places in the scheme of progress, but they live in different atmospheres. The scientific investigator must have freedom to follow his own course wherever it may lead, whereas technical research can be organised and definite problems presented for which solutions of direct service to man are sought. The standard of value in one case is that of knowledge only, while in the other it is that of profit or use. The scientific mind desires to understand Nature; the engineering mind to control her for material purposes.

Some time ago the votes of the readers of an American periodical—*Popular Mechanics*—were taken as to what inventions were considered to be the "seven wonders of the modern world." From a list of numerous inventions, seven had to be selected; and those which received the highest number of votes were: wireless telegraphy, the telephone, the aeroplane, radium, antiseptics and antitoxins, spectrum analysis, and X-rays. Each one of these things had its foundations in purely scientific work, and was not the result of deliberate intention to make something of service to humanity.

It would be easy to give many further instances of the foundation of great industries upon results obtained in scientific investigation. Credit is, of course, due to the engineers who convert laboratory experiments into commercial undertakings, and to inventors for making use of scientific results in the production of instruments and devices for the convenience and comfort of man; but in both cases they are adapters of new knowledge rather than creators of it. The new field is opened by the man of science, but he is usually forgotten by those who afterwards take possession of it.

National well-being can only be secured when the close relation between it and scientific progress is understood. Discoveries which lead directly to developments of industry and manufacture may almost be left to take care of themselves, and the search for them is not likely to be neglected, but it is not the case with those for which no immediate use can be seen, yet almost all scientific research comes within that category. This is the kind of research which needs encouragement more than any other, and demands the greatest amount of originality, inspiration, and enthusiasm, to produce apparently insignificant results. The man who has zeal for work of this kind, who is a born researcher, should be cherished by his country above all others, and every advantage be offered him for the pursuit of knowledge.

When men of science ask for funds for scientific research they do not wish to bury the talents they receive or to derive personal profit from them. Whatever amount is entrusted to them is returned a hundredfold in the results achieved. How many are the researches worthy of assistance, and how small are the funds available for investigations having no obvious practical application, are understood only by men of science themselves. It would be a revelation to people endowed with a larger share of worldly riches to be present at a meeting of the committee of the British Association concerned with the allocation of grants for scientific purposes. Thirty or forty of the leading men of science in the British Isles discuss for several hours how to divide the sum of about 1000*l.* which represents the amount available from the sale of tickets at each annual meeting. There are many applications for grants from committees of each of the twelve sections of the Association, and the amount required has usually to be whittled down to 5*l.* or 10*l.*, which often does not cover the expense of stationery and postage of a research committee. Not one penny goes into the pockets of the men who are conducting the researches, yet claim after claim has to be passed, or reduced to its lowest limits, because the fund is miserably inadequate to meet the demands made upon it.

The Royal Society was unable to find the money required to print Newton's "Principia," and it was published at the expense of his friend Halley. Our scientific societies are in no better position to-day. Their members—most of whom possess but very slender means—pay by their own subscriptions for the publication of the results of their investigations. They sacrifice their leisure, and draw upon their limited resources, not only that knowledge may be increased, but also that the gain may be published to the world, which is free to make use of it.

It is difficult for the man of the world to understand the altruistic spirit which induces men of science to band themselves together in societies having for their sole aim the advancement of knowledge in particular directions; and that these men should themselves pay to enlighten and benefit others by the publication of their researches is almost incomprehensible to the selfish or money-making mind; yet such is the case. While the annual State grant made by Great Britain towards the expense of the publications of learned societies is limited to the sum of one thousand pounds to the Royal Society, several times that amount is provided each year for stationery alone used by members of the House of Commons.

The politicians who pay themselves a salary for the time they devote to party tactics and personal persiflage would be astounded if the proposal were made to provide for the support of Fellows of the Royal Society or of any other scientific institution, yet of the relative values to the nation of the work done in the two spheres of politics and

science, there can be no question. In a splendid building and surrounded with all the appurtenances of precedent and dignity, months and years are wasted in a game of finding weak points in arguments relating to subjects many of which are of doubtful national importance; while the scientific elect of the country are crowded in modest apartments to discuss discoveries which it has cost them much time and frequently much money to complete, and for the publication of which they must themselves make provision. It requires the satire of a Swift to describe the disparity of support afforded to polemics and natural philosophy by a State that owes most of its modern advance to scientific work.

There is no doubt that the greatest contributions to knowledge have been made by men who undertook their inquiries into Nature without thought of proximate or ultimate practical application or pecuniary reward. It is true also that the best kind of scientific investigation cannot be carried on in an atmosphere of commercialism, or where personal profit is the end in view. This, however, does not relieve the nation of the responsibility for seeing that the rare aptitude for original research receives the most generous encouragement. At present a scientific career is the last into which a man should enter who expects a reasonable reward for his knowledge and industry; for it is the least lucrative of all professions. The reason is that its members do not form a corporate professional body to secure for science the position which it should hold in the thought and affairs of the State; therefore, administrators and officials generally pay little attention to its claims. Scientific men should see that fuller national recognition is given to their work, and the programme in *Science Progress* will show some of the directions in which they may well effect improvements, so that the world shall recognise "the great principle that of all forms of human effort, those efforts which result directly in discovery, whether in science or in art, are by far the most important efforts for humanity."

R. A. GREGORY.

EXPLORATIONS ON THE NORTH-EAST FRONTIER OF INDIA.

AMONGST the many activities of the Indian Survey Department not the least in scientific interest is the series of exploratory surveys which have been carried out on the north-east frontier, to the north and east of Assam, in the wild and mountainous hinterland which lies between Tibet and Burma. The scientific interest of these explorations is two-fold, geographical and ethnographical. The region dealt with in the report of Colonel Sir Sidney Burrard (Surveyor-General of India) embraces the principal basins of the rivers Mekong, Salween, and Irrawaddy and the Himalayan catchment areas of the four principal feeders of the Brahmaputra, namely, the Lohit (Zayul), the Dibang, the Dihâng, and the Sabansiri, and for the sheer physical difficulties offered to systematic mapping is probably unmatched by any equal area in the world.

The scantiness of population, denseness of jungle, altitude of ranges, steep precipices, torrential streams and infernal climate have so far practically barred communication between India and China and between Tibet and Burma. It is here that four survey detachments have been working intermittently from 1911 to 1914 to assist each other in cracking that old geographical nut which lay enshrined in the mountains which overhang the course of the Brahmaputra and the sources of the Irrawaddy. We have heard of the remarkable exploits of geographers, such as Captain Bailey, who traversed those regions with unexampled success and vindicated the reputation of earlier native explorers, but we have not heard much of the determined efforts of the official pioneers of scientific mapping, whose work furnishes the basis of all successful explorations.

The scientific interest of work accomplished in the field of geography is naturally great and varied, for it is comprised in a large field of 28,000 square miles of hitherto unknown and unmapped mountains. Perhaps the chief point which calls for recognition is the discovery of a gigantic snow peak (Namcha Barwa), 25,445 ft. in altitude, far to the east of Kinchinjunga. The discovery of a peak in Assam nearly as high as Nanda Devi (25,645 ft.) "marks an epoch," says Col. Burrard, "in the history of Himalayan explorations," and the further fact that the Brahmaputra cuts its passage across the Himalayas at the base of this mountain gives rise to a curious problem in mountain hydrography; for it is noteworthy that the Sutlej, the Indus, and the great river of Hunza all cut through main ranges close to the points of supreme elevation of those ranges. Is this only a coincidence, or are we to seek for a reason in the processes of construction of mountain chains?

Another interesting matter is the absence of falls in the Brahmaputra. This is a feature common to most, if not all, of the great Himalayan rivers which descend rapidly from great altitudes to the plains. There are, indeed, magnificent cascades throughout the Himalayas, and a tremendous drop is not uncommon at the point where a tributary joins its parent river, but there are no falls in the main streams.

As for the ethnographical interest of the regions under review, it is so extensive and embraces such a variety of problems that it is only possible to point out generally that here, if anywhere, are we to find the modern representatives of the very oldest of primeval Asiatic races. We are content to generalise under such terms as Tibeto-Burman, or Indo-Chinese, a vast aggregation of tribes-people who differ so widely in their social idiosyncrasies, and even in anthropological features, that there must almost certainly be amongst them survivals who can help point the way to the very beginning of the human alphabet in Asia. All information that can be obtained about them, about their physical conditions, their habitat,

their manners, methods and creeds, is of the greatest scientific value—all the greater that, as civilisation advances, opportunities for the careful study of these people will surely diminish. It is indeed the human interest in exploration which now specially calls for the attention of geographers, for such slight glimpses as we can get into the earliest stages of human existence are getting less and less. They are rapidly passing away, whilst the great wide spaces of unexplored world-surfaces where humanity is not, and never was, can well await the geographer of the future.

T. H. HOLDICH.

POTASSIUM SALTS AND AGRICULTURE.

ONE of the first results of the European War was to cut off the supply of potassium salts, which play a large part as fertilisers in modern agriculture. Our crops of potatoes and our supplies of milk are particularly dependent on abundant supplies of these particular fertilisers, and practically all the world's supply has hitherto come from the Stassfurt deposits in Germany.

The three crops that stand most in need of potassic fertilisers are potatoes, mangolds (used for dairy cows), and sugar beets. In addition, two types of soil need them for other crops: light sandy soils and peaty soils. Enormous amounts are required in Germany, where vast areas of these two types occur, and where sugar beets and potatoes are largely grown; in Sweden for the same reasons; in France and the United States for the production of sugar beets; and in this country for mangolds and potatoes. It is not surprising, then, that nearly ten million metric tons per annum are consumed.

Fortunately the conditions in British farming are such that potassic fertilisers are not indispensable, at any rate for two or three years. Potassium salts form insoluble combinations in the soil, and do not wash out; any excess not removed by the crop is therefore in safety. Further, a considerable proportion of what is absorbed by the crop finds its way back to the soil in farmyard manure, the materials sold off the farm not as a rule containing much potash. The supplies stored in the soil can be utilised to advantage by a suitable dressing of lime or chalk, which displaces the potassium from its insoluble combinations, and also by addition of sodium chloride, which has the same effect and in addition economises the consumption of potassium by the plant.

But there are sources still open to the farmer. Seaweed contains considerable quantities of potassium, which would become available on a proper reorganisation of the kelp industry on modern lines. The farm itself can also supply something. At this time of the year a good deal of hedge cleaning has to be done to make a clear way for the plough, while later on the hedges have to be cut back to keep them sufficiently low. The material is very bulky, and has to be burnt straight away; it yields an ash found at Rothamsted to contain about 10 per cent. of potash (K_2O), which is thus nearly as rich as kainit (12·5 per cent. K_2O). The hedges from each ten acres of land yield about 1 cwt. of ash, so that a 300 acre farm—quite a usual size for a holding—could provide itself with about 30 cwts. per annum if all could be collected. Unfortunately collection is a matter of some practical difficulty excepting in fine dry weather.

Taking all circumstances into consideration, however, it does not appear that British agriculture will suffer for two or three years from potash starvation, though when conditions become more normal the farmer will no doubt be glad enough to replenish the stocks in his manure shed and his soil. Up to the present it does not appear that any other of the common fertilisers will be cut off through the war. Indeed, the tendency is all the other way, and some of the supplies usually shipped to the Continent are now available for use in this country.

E. J. R.

NOTES.

THE anniversary dinner of the Royal Society, usually held on St. Andrew's Day, November 30, will not be held this year.

THE following have been elected officers of the Cambridge Philosophical Society for the ensuing session, 1914–15:—*President*: Prof. Newall. *Vice-Presidents*: Dr. Barnes, Prof. Seward, Dr. Shipley. *Treasurer*: Prof. Hobson. *Secretaries*: Mr. A. Wood, Mr. F. A. Potts, Mr. G. H. Hardy. *New Members of the Council*: Mr. J. A. Crowther, Mr. H. H. Brindley, Dr. Fenton, Mr. H. Hamshaw Thomas.

ACCORDING to the Christiania correspondent of the *Morning Post*, a monument in the form of a monolith 15 ft. high has just been completed at Christiania and is intended to commemorate the gallantry of the late Captain Scott and his companions in their Antarctic expedition. It has been subscribed for by Norwegian friends of the explorer. On the front are inscribed the names of Captain Scott and those who died with him, while at the back is a short record of the expedition.

A CASE is recorded in the daily papers of a soldier who, during a recent engagement, was shot in the forehead, the bullet passing out of the back of his head without killing or even stunning him. He remarked, "Everything seems green all round me." When in the hospital tent he still saw everything green, but otherwise made no complaint. This case appears to favour the cerebral theory of colour vision of Dr. Edridge-Green, the shock to the brain having altered the discriminatory apparatus so that impulses caused by green rays had a preponderating influence.

THE opening meeting of the one hundred and sixty-first session of the Royal Society of Arts will be held on Wednesday evening, November 18, when an address will be delivered by Sir Thomas H. Holdich, vice-president and chairman of the council. The following are among the arrangements for meetings before Christmas:—November 25, Sir William A. Tilden,

"The Supply of Chemicals to Britain and her Dependencies; December 2, Dr. W. R. Ormandy, "Britain and Germany in Relation to the Chemical Trade"; December 9, Mr. W. A. Young, "Domestic Metal Work of the Eighteenth Century"; December 16, Sir William Abney, "Testing Pigments for Permanence of Colour"; December 17, Dr. F. Mollwo Perkin, "The Indian Indigo Industry."

WE notice with satisfaction that various scientific societies are welcoming Belgian refugees who are interested to attend their meetings. The Society of Engineers has opened the offices of the society at 17 Victoria Street, Westminster, daily from 10 a.m. to 4 p.m. (Saturdays, 10 a.m. to 1 p.m.), to Belgian engineers who are now in England on account of the war, and they are invited to apply to the secretary when they are in need of any information. Belgian engineers who are unable to call are invited to send their names and addresses to the secretary so that they may be in touch with their colleagues and receive invitations to the meetings. A committee of the Linnean Society has been empowered to invite Belgian botanists (whether ladies or gentlemen) to attend the meetings of the society and to make use of the library. The council of the London Natural History Society, too, invites any Belgian refugee interested in natural history to attend the meetings of the society and offers them the use of the society's library and collections. Particulars of the meetings, which are held at Hall 20, Salisbury House, London Wall, E.C., at 7 p.m. on the first and third Tuesdays of the month, can be obtained from the honorary secretary, Mr. J. Ross, 18 Queen's Grove Road, Chingford, N.E.

MR. H. W. CODRINGTON, of the Ceylon Civil Service, has compiled a useful catalogue of the collection of the European (exclusive of Roman) and Muhammadan coins in the Columbo Museum. The Indo-Portuguese and the Dutch coinage of the period 1640–1796 are well represented in the collection, and this catalogue, which is illustrated by a good series of process plates, will be of considerable interest to numismatists.

THE Journal of the Royal Society of Antiquaries of Ireland for September is largely occupied with a guide to the antiquities of Dublin and the neighbourhood provided for the use of the meeting which was held in June last. This publication is written by the most competent authorities, is well illustrated, largely from old engravings, and contains a fuller and more judicious account of the local antiquities than can elsewhere be procured. The description of St. Doulagh's Church, with its remarkable anchorite's cell, is specially to be commended.

IN *Man*, for November, Mr. J. Reid Moir discusses the question of the striation of flint surfaces in relation to the speculations of Dr. W. Allen Sturge, who attributes the markings on flints found in north-west Suffolk to at least six minor glaciations which occurred in Neolithic times, and he thus pushes back the advent of Neolithic man to a period about two hundred thousand years ago. Mr. Reid Moir, as the result of experiments on flint scratches, points out that this substance is far from being homogeneous, and that the belief in its hardness applies only to a freshly broken, unchanged sound flint. Exposure to the atmosphere produces patination or softening. It is thus impossible that flints long exposed to the weather could retain these scratchings for a lengthened period, and those found lying on the surface may owe their striation to ordinary causes, possibly connected with agricultural operations. The composition and character of flint are so important in connection with the age attributed to implements made of this material, that a more thorough examination of flint structure and its susceptibility to striation is an inquiry which should be systematically undertaken by a committee of competent geologists and archæologists.

IN the Journal of the Royal Society of Antiquaries of Ireland for September Mrs. Brunicardi contributes an interesting summary of our existing knowledge of the shore-dwellers of ancient Ireland. The map shows the curious distribution of their kitchen-middens. They appear at only three sites on the east coast, while on the west and south they are fairly numerous, chiefly in Donegal, Galway, Clare, Kerry, and near the harbours of Cork and Waterford. The writer discusses these remains in great detail with references to the original authorities. Very little pottery and no evidence of the use of metal are found in them, and Mr. Knowles regards them as among the earliest remains we possess of the Neolithic age. These shore-dwellers appear to have been a distinct race, probably a degraded one, living almost entirely on shell-fish, periodically migrating in search of food, but possessing what may be termed headquarters to which the whole tribe sometimes returned, and this they regarded as their home.

IN *Folk-Lore* for September Mrs. B. Z. Seligmann discusses the curious customs of demon possession and devil-dancing known in Egypt as the Zâr. After a full description of the rites, she arrives at the conclusion that they may have a double origin, from Abyssinia and the Sudan. The word Zâr is clearly Abyssinian, and must have been recognised in Egypt before the opening of the Sudan by Mahomed Ali and the consequent importation of black slaves. It must be remembered that the Red Sea route has been open for more than 2000 years, while intercourse with the Upper Nile has been intermittent, generally confined to raiding and plundering. This route, again, was barred by the Christian kingdom of Aloa, which up to the fifteenth century formed a barrier between Egypt and the Sudan. But whatever date may be assigned to the introduction of the Zâr into Egypt, there can be no doubt that its present popularity among the higher classes is due to the influence of black slaves received into the harems on a footing of perfect equality. Hence their cult of the dead was soon modified into a general belief in spirits which reinforced that which had perhaps already reached Egypt from Abyssinia. Mrs. Seligmann's graphic account of these rites may be usefully compared with that

recently published by Major A. J. N. Tremearne, of Hausa customs of the same kind in his valuable work entitled "The Ban of the Bori."

WE have received from Mr. Edwards, of High-street, Marylebone, a catalogue of works relating mainly to fishes, fisheries, and angling.

TWO excellent plates illustrate an article by Dr. Annandale in vol x., part 5, of Records of the Indian Museum on new and other stalked barnacles from Indian waters. Most of the species are of minute size; the most remarkable being one (*Heteralepas reticulata*) found in clusters on the spines of a sea-urchin. It is easily recognised by its "honey-pot" shape.

A MUCH compressed report, crowded with detail, by Mr. T. Southwell, on the fauna of the Ceylon pearl-banks, and a second on the food of certain marine Ceylonese fishes have been issued in the Educational Section (Science and Art) of the Ceylon Administration Reports for 1912–13. Portions, at least, of the notes are promised in another and fuller form, when it probably will be easier to grasp and assimilate their contents.

IN the October issue of *Naturen* Mr. O. J. Lie-Pettersen continues his illustrated account of the Norwegian tit-mice. The birds of Sarawak form the subject of an article in vol. ii., No. 5, of the Sarawak Museum Journal, by Mr. R. B. Williams, who has made coloured sketches of about one hundred species, from examples shot by himself. These sketches are accompanied by notes on the appearance of the freshly-killed birds and on the habits of the various species, and it is from these that the article has been compiled by Mr. J. C. Moulton.

ACCORDING to a notice in the November number of the *Museums Journal*, Dr. F. A. Lucas, director of the American Museum of Natural History, New York, disapproves, as a general rule, of large special exhibits in zoological museums, on the ground that when they are closed there is a marked falling off in the normal number of visitors. This, however, has not been the experience at the Natural History branch of the British Museum, as a result of the various special exhibitions which have been displayed at different times during the last few years; and even if it were the case, it would afford no argument for the abandonment of such temporary "side-shows."

IN addition to the gift of the type skull of the perissodactyle mammal *Pliolophus vulpiceps*, to which allusion has been made previously in our columns, Mrs. Richard Bull, widow of the late vicar of Harwich, has presented to the British Museum (Natural History) a skull and three shells of one or more of the three large species of marine turtles of the genus Lytoloma which occur in the London Clay of the Essex coast. The museum has also secured a specimen of the chelonian from the London Clay originally described by Owen as *Emys testudiniformis*, but now referred to the American fresh-water genus Chrysemys. It is in far better preservation than the type, and hitherto only known, specimen.

A GROUP of three East African buffaloes shot during the Roosevelt expedition was set up some time ago in the U.S. National Museum, amid an imitation of African scenery constructed of such material as was obtainable at Washington. This, however, was only a makeshift, and the museum has recently procured from East Africa a quantity of papyrus and reeds for the purpose of making a really vivid model of a buffalo-swamp. In the case of the papyrus the stems are slit open, the pithy interior removed and replaced by plaster, and the whole painted green. For the last few months the buffalo group has been withdrawn from public exhibition; but according to an announcement made by the Smithsonian Institution at the end of October, it was then shortly to be reinstated with its new surroundings complete.

THE October Bulletin of the American Geographical Society contains a preliminary report by Mr. R. S. Holway on the recent volcanic activity of Lassen Peak in northern California. The mountain, which rises at the southern end of the Cascade Range to a height of 10,437 ft., is an old volcanic cone from which a lava flow occurred some two centuries ago. On the north side of the bowl of the old crater, a series of steam explosions, beginning on May 30 last, has opened a new vent, from which stones have been thrown over an area more than half a mile in diameter. No freshly molten lava has been seen, and no heat has been noticeable except that of the escaping steam. Mr. Holway gives a list of twenty eruptions up to July 15. The formation of this new vent is the first recorded instance of volcanic activity witnessed in the United States, excluding the outlying regions.

WE have received from Japan the three parts of the Bulletin of the Imperial Earthquake Investigation Committee which were issued in the months of July, August, and September of the present year. The first two of these are devoted to a discussion by the able seismologist, Prof. Omori, of the eruptions and earthquakes of Asama-yama from 1911 to the date of issue. The records of the seismographs at the volcano-house of Yuno-taira and more distant localities are compared with the observations made in the crater of the volcano, the general conclusion arrived at being that the activity within this gigantic volcanic vent is now gradually subsiding. In the number issued in September, the same indefatigable observer gives a graphic account of his own studies of the Sakura-jima eruptions and earthquakes in January, 1914. The author was a member of the Commission sent by the Japanese Government to prepare a record of that eruption, which Prof. Omori thinks "may be counted, in point of the magnitude of disturbance, as one of the greatest volcanic catastrophes in modern times." An account of this outburst appeared in NATURE of January 22, 1914 (vol. xcii., p. 589). The bulletin is published in English, and the printing and illustrations reflect the greatest credit on the Japanese publishing office. More than fifty plates, including exquisite photographs with clear maps and diagrams, illustrate these three numbers, which constitute a very important contribution to the sciences of seismology and vulcanology.

THE Bulletin of the Imperial Institute (vol. xii., No. 3) contains, in addition to reports on the results of the scientific and technical work of the staff on various colonial products, a special article on the agricultural resources of the Zanzibar Protectorate by Mr. F. C. McClellan, Director of Agriculture, Zanzibar, who describes the climate and system of land tenure in this portion of the Empire, discusses questions of labour and wages, and deals fully with crops and products, the chief of which are coconuts and cloves. In the latter article Zanzibar has practically a monopoly of production. In connection with the campaign for the capture of German trade an article on the trade in palm kernels is of importance as showing that a large proportion of the exports of palm kernels from West Africa are shipped to Germany, where they are used as the source of palm kernel oil and of cake for feeding live-stock, much of the palm kernel oil being re-shipped to this country. This important trade and industry could be well carried out in this country. Other articles deal with the utilisation of waste fish as a source of manure, the tin resources of Australia, South Africa, and Nigeria, and the trade of the Seychelles. Prof. W. R. Dunstan's address at the opening of the third International Congress of Tropical Agriculture (June, 1914) is printed *in extenso*.

THE *Scientific American* for October 10 contains several features of particular current interest. In an editorial the view is put forward that in the event of conscription becoming universal, scientific men should be exempt. They are of incalculable value in the advancement of mankind, and as such their loss would entail greater sacrifices than could be compensated for by their use in the fighting field in which their efficiency and their numbers would probably be too small to have any appreciable influence. In a short note a method is given of hardening the concrete floors of factories. A mixture of 15 to 20 lb. of iron dust with 100 lb. of cement and twice that amount of sand is applied as a surface coating about an inch thick.

WE learn from the Smithsonian Institution that Mr. T. W. Smillie, who has been photographer to the United States National Museum in Washington for the last forty-five years, has gathered together and arranged for the museum a collection of ancient and modern photographic apparatus and specimens. It is claimed that this collection is the most complete in the world. It includes what is believed to be the first American camera, namely, that made in 1839 according to Daguerre's specification, for Dr. S. F. B. Moore; also a print from one of Niepce's plates made in 1824, several fine Daguerreotypes dating from 1839 and onwards, specimens of Fox Talbot's earliest process, and his calotypes, and some early examples of "moving pictures."

JUST as everyone should know something about the general rudiments of astronomy so a knowledge of the elements of our weather and climate should be universally understood in these isles. The earlier such knowledge is acquired the more natural is the interest taken in such figures and diagrams which appear in our daily papers. Besides, we all experience our "weather," and this should be sufficient to bring home to us the importance of understanding such data as are thus placed before us, and should make us wish to take an intelligent interest in some of the elementary principles. Under the title of "Weather Chart Exercises" (British Isles and West of Europe), compiled by Miss L. M. Odell, and published for the University of London Press by Messrs. Hodder and Stoughton (London), we have before us a series of exercises which have been given in connection with the explanation of the weather charts issued by the London Meteorological Office, and in the working out of climate with special reference to the British Isles. The exercises consist in drawing monthly curves of rainfall and temperature, drawing isotherms and isobars, differentiating between high- and low-pressure systems, and many other important factors regarding weather. All the data which are to be used are given in tables, printed forms and charts accompanying them so as to minimise the time spent by the pupil in unnecessary and mechanical work not really belonging to the subject. The exercises are arranged in a progressive order of difficulty and the treatment throughout is excellent and reflects great credit on the compiler. The fact that the new units (millibars), as well as the old, are employed, speaks well for the up-to-date character of the work. It may be suggested that as the map showing the "observation stations" and the "conversion tables" are so frequently to be used both of these should be printed on folding leaves at the end so as to be before the student on whatever page he or she may be working.

IN the *Biochemical Journal* (vol. viii., No. 4, p. 438) Miss M. Cunningham and Dr. C. Dorée discuss the formation of ω-hydroxyfurfuraldehyde from various carbohydrates on distillation with hydrochloric acid under the conditions generally used in estimating pentoses by the well-known Tollens-Kröber method. The formation of this aldehyde is a source of error in estimating the pentoses, but it is shown that the condensation which produces the true furfural is almost completed before the hydroxymethyl derivative begins to distil over, and by using aniline acetate test paper it is possible to distinguish between the separation of the two aldehydes, so that little error is made in the estimation of pentoses or pentosans. Light is thrown in this paper on the so-called "furaloid" constituents of plants; in all probability these are merely hexose-yielding substances, which give hydroxymethyl aldehyde on distillation with acid, the latter substance being then largely decomposed by a second distillation with acid.

IN *Science Progress* for October Dr. H. W. Bywaters gives an account, under the title "Vitamines," of recent work on nutrition, and of the light thrown by the researches of Funk, Hopkins, Osborne, and Mendel on the cause of such "deficiency diseases" as beri-beri, pellagra, scurvy, and rickets. These researches emphasise once again the importance of the part played by the "infinitely small" in vital changes, a part which has been more and more realised during recent years with the increased knowledge obtained of enzymes and similar agents. In a paper on the

biochemistry of respiration, Dr. H. M. Vernon shows how recent research points in the main to its being dependent on intracellular enzymes—in some cases purely hydrolytic, in others partly hydrolytic, partly oxidative. Dr. R. W. Hegner deals with the germ-cell cycle in animals, Mr. A. G. Thacker has a paper on extinct apes, whilst Mr. W. L. Balls considers the question of the aid to be given by science in the future to the growing and utilisation of cotton. The theories of dyeing are discussed by Mr. E. A. Fisher, the problem of smoke abatement by Mr. J. B. C. Kershaw, whilst Mr. James Huneker has a short illustrated article on tornadoes and tall buildings.

THE geared turbine Atlantic liner *Transylvania* ran her trial trips a fortnight ago, and the observations of a representative of the *Engineer* who was present are of interest. There is some vibration in certain parts of the ship, but nothing to be compared with that which would be experienced with reciprocating engines. It was local, and of a very innocent description; it fact, it might be described as merely an absence of stillness. Owing to the high revolution speed of the turbines—1500 r.p.m.—the vibration speed is high. The noise in the engine-room is at present quite considerable, and is the typical roar of high-speed gearing. It is not easy to see how the noise may be eliminated entirely, in spite of the beautiful machines invented for cutting the gears. On the third-class passenger deck, gear noise disappeared totally at a distance of about 150 ft. from the engine-room entrance. On the deck above this, the noise disappeared at about 90 ft. from the companion-way. In fact, in the space used for passengers, the noise is just noticeable while listening carefully for it, and hence cannot be considered objectionable from the passengers' point of view, especially as the sound is not high-pitched.

THE Carnegie Institution of Washington has issued the first part—A to H—of the "Index to United States Documents relating to Foreign Affairs, 1828–61," which is to be completed in three parts. The index is the work of Miss Adelaide R. Hasse, the head of the department of documents in the New York Public Library, and an idea of the magnitude of her task can be formed from the fact that the present instalment of the index runs to 793 large pages. In addition to the reports of Congress, the following series of documents have been indexed: the Senate Executive Journal, for diplomatic and consular appointments and treaty ratifications; the Opinions of the Attorneys-General, for decisions on questions of international controversy; the Statutes-at-Large, for acts and resolutions relating to international affairs; and the Congressional Globe and its predecessors for speeches and correspondence.

OUR ASTRONOMICAL COLUMN.

COLOURS OF STARS IN THE CLUSTER M13 (HERCULES).—When stars are too faint to be spectroscopically examined, some idea of the type of spectrum involved can be gathered from their visually observed colour. It may happen that the stars are even so faint when seen in a powerful telescope that they exhibit no colour at all; it is then that the photographic plate is called in, the sensitive film being a great differentiator of colour. In the case of star clusters the opportunity is afforded of comparing a great number of stars, and it is of extreme value to know whether the stars involved are all of one physical condition or same spectral type, or whether they show representatives of all types. Especially is this the case when it is remembered that star clusters are most remote and must therefore be of immense magnitude. The photographic determination of the colours of some of the stars in the cluster M13 in Hercules is therefore of great value in this connection, and the research which we owe to Prof. Barnard (*Astrophysical Journal*, vol. xl., No. 2, September) is one that will be read with interest. In this paper the stars are practically divided into two colour classes, namely, blue stars and yellow stars, and this has been done by comparing two photographs of the same cluster taken under two conditions. One photograph was secured with the 13-in. astrographic refractor of the Potsdam Observatory, and the other with the 40-in. refractor of the Yerkes Observatory. The optical conditions on the Potsdam photograph were such that the blue stars were relatively brighter than the yellow stars, while on the Yerkes plate the reverse was the case. A comparison of the plates thus afforded a means of separating these coloured stars, but care had to be taken to eliminate all comparisons of star images where variability might be involved. Prof. Barnard concludes that in this cluster there exist stars of extremely different types, and hence, by inference, that there are stars of all the different spectral types. The paper is accompanied by reproductions of the Yerkes and Potsdam plates and an index chart.

THE ELECTRIC ARC AND SPECTRAL LINE DISPLACEMENTS.—Numerous references have been given in this column to investigations on the causes in terrestrial spectra of displacements of lines from their normal positions. In fact, the inquiry which was started some years ago to select and adopt certain standards of wave-length of iron, etc., show that little was known about the behaviour of lines under different conditions of electric current, arc length, etc. All attempts therefore to arrive at a final selection of lines suitable as standards are of fundamental importance to spectroscopists and astro-physicists, and in this report the communication by Mr. T. Royds (Kodaikanal Observatory, Bulletin xl.) on an investigation of the displacement of unsymmetrical lines under different conditions of the electric arc will be welcomed. To find a light source giving normal wave-lengths for all classes of lines is therefore an inquiry of the first order, and the present paper is an advance in that direction. The results of the present work are summed up in a series of brief paragraphs at the end of the paper, and while only a few of these can be referred to here, the reader should consult the original bulletin. When the spectrum of the region of the arc near the negative pole is compared with that of the centre, the unsymmetrical lines are displaced in the direction of their greater widening; symmetrical lines have very small or no displacements. The displacement near the positive pole is about half that at the negative. A displacement of the same sense as that at the poles is produced at the centre of the arc by increasing the current or shortening the arc. The displacement at the negative pole is reduced if only the positive pole is supplied with the material producing the spectrum. Displacements occur in the arc *in vacuo*, but to a much smaller extent than in air, and he suggests that the arc *in vacuo* is a better source for the determinations of standards of wave-length and for comparisons with the sun's spectrum.

ANNALS OF THE ZÔ-SÈ ASTRONOMICAL OBSERVATORY.—The seventh volume of the Annals of the Zô-sè Observatory is divided into four parts, and deals with solar, double-star and cometary observations made during the year 1911, together with a discussion of some early star observations made about the year 1744. The observations of the sun are confined to spots, faculæ, and prominences, and, in addition to the observations themselves, a very complete summary is given of their distribution in both latitude and longitude, with reproductions from the drawings of the chief prominences observed. Part ii. deals with the observations, both visual and photographic, of the double and multiple stars; while the third part is devoted to the observations of comet Brooks (1911*c*) and comet Borrelly (1911*e*). In the last-mentioned part comparisons are made with the observations of others who studied these comets, and an interesting series of reproductions from photographs of comet Brooks accompany the text. The last and fourth portion is devoted to a description and reduction of a catalogue of stars observed at Pekin under the Emperor K'ien-Long in the year 1744. Two reproductions of the old Chinese charts are given, and the stars have been identified and their positions reduced to the epoch of 1875, with accompanying charts. Historically interesting are the translations of the early decrees relating to the staff of the observatory and of the preface to the catalogue.

THE DEVELOPMENT OF CHEMICAL INDUSTRIES IN THE BRITISH ISLES.

UNDER the title of "The Capture of Germany's Chemical Industries," the *Chemical News* has published (vol. cx., p. 151) an editorial article dealing with the situation opened to English chemical manufacturers by the war, a situation which has already formed the subject of an article in NATURE (September 17, No. 2342). "A unique opportunity," it is stated, "is now offered of developing industries hitherto swamped by foreign competition, and the nation relies upon the enterprise of its scientific men to attack the subject with promptitude and vigour. It is satisfactory to find that the Government has already taken the matter up, and a Committee has been appointed to consider and advise as to the best means of obtaining for the use of British industry sufficient supplies of chemical products, colours, and dyestuffs of kinds hitherto largely imported from a country with which we are at present at war."

The same subject forms the text of an important article in the *Chemical World* for October, which, after reviewing the conditions which led to Germany's occupying a practically unassailable position in this field before the war, issues a note of warning as to the methods which must be adopted if England is to gain success in the future under greatly modified conditions.

"The combination of banking facilities, system of factory management, and scientific thoroughness in detail was undoubtedly one which our manufacturers found especially formidable." If the products which Germany has made, however, are to be manufactured under English trade conditions, "not during the reign of panic but as a permanent venture, it will need a strong pull and a pull altogether by the interests which are the equivalent of those enumerated above, be they what they may. A good deal of loose talk about the effect of the patent law has been beside the mark, when it is remembered that the only protection accorded to Germany in this respect was that given to the one who got to the Patent Office first. The race was to the strong; to the one best organised. It would be idle to fight such conditions, which represent modern scientific warfare at its best, with the tools of the 1870's."

A close inspection will confirm the statement made by a director of one of the largest German aniline dye manufactories, that not 10 per cent. of their products or output was protected by patent rights but by organisation along German lines. "Equally vague has been the statement that want of free alcohol has been at the root of England's failure. With alcohol at the cost of rain-water and free trade in the patents of other countries, the result would have been much the same in the absence of that spirit of scientific and deliberate correctness and efficiency and the peculiar self-effacement of scientific workers who, directing operations in the works at practically the wages of superior workmen, have achieved such results in the worldwide endeavour on the part of Germany to outclass all other nations in this special branch of industry."

There is no doubt that in the past there has been a very great neglect by many manufacturers of the services of the properly trained chemist. The writer recalls one case of a large English chemical firm, which had been the pioneer in elaborating the processes of manufacture of a certain widely used acid; after the death of the chemist who had initiated the processes which had brought this firm a golden revenue, operations were carried on for nearly twenty years, without a single trained chemist being employed in the factory to supervise or control the processes or introduce improvements, although the processes were of a complicated character, and the output represented a value of more than 150,000*l.* per annum. By this time Continental competition had become so severe that it was almost hopeless to regain ground which had been steadily lost year by year in this particular field.

There is little doubt that the value of employing numerous chemists in chemical works is becoming more and more appreciated in this country. The supply of well-trained chemical workers which is available for the coming struggle will be the most important factor in its decision.

AUSTRALIAN WELLS.[1]

THE great Australian artesian basin is, says this report, "undoubtedly the largest artesian area in the world, but at the same time there has probably been less work done on it than on any other artesian basin known" (p. xi.). There are two conflicting explanations of the nature of this basin. According to the older official view it is artesian, using that term in its original sense for a synclinal in which water enters at a high-level intake, spreads through a permeable layer under a wide cover of impermeable beds, and is forced up through wells by water pressure from the higher parts of the water-bearing layer. The intake beds beside this Australian basin were considered to be so extensive, so porous, and so well supplied by rain and streams that there need be no fear of the supply being appreciably reduced by artificial wells.

According to one calculation the wells put down in Queensland up to 1901 used only 1/183 of the annual supply from the rain, and other estimates have calculated that the supply, without any renewal, would last for 3000 years. According to a second hypothesis, the U-tube conception of these wells is inconsistent with the variations in the head of the water and in its chemical composition, and also with its high temperatures. According to this explanation the bulk of the water is water of cisternage, supplemented to a

[1] "Report of the Interstate Conference on Artesian Water." Sydney, 1913, xv., 207. Pp. 68+40 maps and plates.

minor extent locally by rainfall; and the water is ejected, when the water-bearing layers are reached by bores, in consequence of gas pressure due to the introduction of hot plutonic water and to rock pressure due to the weight of the overlying shales on the water-bearing sands and sandstones. The question is practically important, for the policy to be followed in the administration of these well waters depends upon which explanation is adopted. The advocates of the first theory insisted that there was no evidence of any reduction on the yield of the wells and that no diminution need be feared. Some of the advocates of the alternative theory insisted that there would be a serious fall in the discharge.

The problems connected with the supply have been referred to an Inter-State Commission, which has collected much valuable evidence and an atlas of most useful maps and plates. It considered, amongst other questions, the corrosion of the tubes used for lining the wells, which in some localities rapidly decay; the irregular distribution of this corrosion illustrates the great local variations in the nature of the bore waters. Prof. Fawsitt, who gave evidence before the Commission, attributes the corrosion to the action of carbon dioxide in the presence of free oxygen.

One of the most striking maps presented to the Commission is that showing the widespread diminution from the Queensland wells; many have ceased to flow and others are greatly reduced in volume. At first the advocates of the water-pressure theory attributed such cases to the choking of the bore or to the escape of water around the bore tubes; but the Commission rejects these explanations. The distribution of the dwindling supplies in Queensland shows that the cause is very widespread, and is subject to local variations which it is difficult to explain except upon the gas-and-rock-pressure hypothesis. The Commission has adopted the water-pressure theory, but it makes two great concessions towards the later theory. Its report remarks that "the gas in these waters must undoubtedly to some extent assist in bringing the water to the surface." The Commissioners add that the rise of the water is primarily due to hydraulic pressure; but as they recognise that gas pressure assists, the old calculations as to the water levels which have been represented as the strongest argument in favour of the water-pressure theory can no longer carry much weight. The Commission has also adopted a definition of artesian water which abandons the basis of the older hypothesis.

"*Artesian and Sub-Artesian Water.*—Water struck in bores may be under ordinary atmospheric pressure, or it may be under a pressure exceeding that of the atmosphere. In the former case the water may be termed ordinary ground water; and in the latter case the water may be termed either artesian or sub-artesian. Artesian water is subject to a natural pressure sufficient to force it above the surface of the ground" (p. ix.). According to this definition all water which rises to the surface of the ground, whether through any limestone source or boiling volcanic spring, is artesian—an *extensio ad absurdum* of the term.

IONISATION.[1]

IONISATION is the process by which ions—particles charged with electricity—are produced in a solid, liquid or gas. This address is confined to the consideration of ions in gases and deals with two questions: (1) the nature of the ions, (2) the process by which they are produced. The evidence as to the nature of ions is derived from experiments on their mobility which have shown:—

α. The mobility of a positive ion depends only on the gas through which the ions are moving and not on the nature of the gas out of which the ions are formed.

β. The mobility of the ions in a gas at constant density is independent of the temperature.

γ. There is a considerable number of gases in which the mobility is very approximately inversely proportional to the square root of the density of the gas.

δ. In the case of negative ions there is an abnormal increase of mobility when the pressure is reduced below a certain value, and there is some evidence that this is also the case for positive ions at very low pressures.

Two theories of the mobilities of ions were considered, one founded on the view that the action between ions and molecules is analogous to impacts between hard elastic spheres, the other on Maxwell's theory of forces between ions and molecules varying inversely as the fifth power of the distance between them.

It is shown that (α) follows from the second theory provided the ion is a cluster of which the mass is considerably greater than that of a molecule of the gas through which it is moving. On this supposition it follows also from the first theory if we suppose in addition that all ions in a given gas are of the same size.

(β) follows at once from the second theory; to explain it on the first theory we must suppose that the size of the ion varies with the temperature in a definite way. The necessary relation can be deduced from thermodynamical principles if we suppose that the force between an ion and a molecule is analogous to that between a charged point and a sphere which is either a conductor of electricity or has a high specific inductive capacity.

(γ) requires on theory one that the ions in these gases should be of the same size, on theory two that the molecules of these gases should exert the same force on a charged point at a given distance.

(δ) follows on either theory if the ion dissociates at low pressures so that free corpuscles are present in the gas.

With regard to the process of ionisation, the first stage of this in the vast majority of cases consists in the detachment of an electron or corpuscle. Evidence as to the method by which this takes place is afforded by determinations of the velocity with which the electrons are ejected from the body.

In the case of ionisation by light or Röntgen rays, this velocity depends primarily on the wave-length of the radiation, not upon its intensity, nor, at any rate to any great extent, on the nature of the molecule from which the corpuscle is ejected. This velocity is far greater, even when every allowance is made for resonance, than can be accounted for if we suppose that the energy of the light is uniformly distributed, and that the corpuscle acquires its velocity by the action on it of the electric force in the wave. Another explanation not open to these objections was put forward.

When ionisation is due to the action of moving electrified particles, whether positive or negative, the results are quite different. The velocity of the ejected particles (δ-rays, as they are sometimes called) does not seem to vary much, if at all, with the velocity of the particles which eject them, and is of the same order whether these particles are positive rays or the much swifter kathode rays. The method of ejection by the impact of such particles was considered, and suggestions as to a possible theory and some of its consequences thrown out.

[1] Abstract of the presidential address delivered before the Physical Society on October 23 by Sir J. J. Thomson, O.M., F.R.S.

DENTAL MUTILATIONS IN NEOLITHIC HUMAN REMAINS.

MR. J. W. JACKSON, of the Manchester Museum, has reprinted from the *Journal of Anatomy and Physiology* (vol. xlix.) an interesting paper on dental mutilations in Neolithic human remains. These were first brought to light in the case of the celebrated Galley Hill skeleton, and further examples have now been discovered at the cave known as Dog Holes, on Warton Crag, Lancashire. In these latter examples the lower jaw was remarkable for the absence of the second premolar teeth on each side, and for the obliteration of all traces of the alveoli.

It is well known that during the rites of tribal initiation among the natives of Australia, the Ashantis, the Masai, and Sudanese tribes, and others, some of the lower teeth are removed. Prof. Elliot Smith has described a similar case in Ptolemaic-Roman burials in Nubia, and it prevailed in early Egypt. The occurrence of similar examples in British Neolithic interments is thus of considerable interest. Mr. Jackson is inclined to regard the practice in Britain as genetically related to similar customs elsewhere, particularly in eastern Africa, and he assumes that its occurrence among the early Egyptians some 3400 years B.C. represents a date only slightly earlier than that of the Neolithic age in Britain. It seems evident, he urges, that these early Neolithic people had retained some remnant of a rite or custom, formerly in use among themselves, or adopted from neighbouring tribes during their migration from their early home in the East.

Further, Mr. Jackson thinks we may assume from the presence of mutilations in so few of the jaws of what may be regarded as one clan or family group that, as in the case of some Australian aborigines, the significance of the operation might likewise have been lost, and that the practice became degraded into a merely optional custom through the isolation of the tribes in their northward migration, or through some advance in civilisation. In any case, the investigation may result in establishing a cultural chain linking the British Neolithic tribes with the pre-Dynastic Egyptians, by way of the Iberian Peninsula and northern Africa.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE Australian meeting of the association was remarkable for the extended nature and great interest of the excursions which had been arranged by the various local committees.

An advance party arrived in Western Australia on July 22, and were conducted by Prof. Woolnough, of the University of Western Australia, to the Irwin River, two hundred miles north of Perth, where sections were examined showing Permo-Carboniferous beds unconformably overlain by Jurassic rocks. The Permo-Carboniferous series includes near its base a bed of Conglomerate, the Lyons Conglomerate, which is shown by its numerous striated pebbles to be of glacial origin. The Lyons Conglomerate has been proved to extend for a distance of two hundred miles and is believed to be contemporaneous with similar beds in other parts of Australia and in South Africa, South America, and India.

On returning to Perth sections of pre-Cambrian slates at Armadale Brick Pits, and of crush-conglomerates of similar age at Helena River were examined, and on July 28, several additional members having joined the party, a start was made for the Stirling Ranges, 250 miles to the south, where highly contorted quartzites of unknown age were seen. Again turning northwards, the Archæan gneisses of the Toodyay railway section, which are covered unconformably by quartzite, probably of Huronian age, were visited, and, finally, an examination was made of the Coolgardie and Kalgoorlie area, both the underground workings and the surface plants receiving attention. On August 4 the party sailed from Fremantle for Adelaide.

From Adelaide a number of chemists and geologists visited Port Pirie, where the smelting works of the Broken Hill Proprietary Company were inspected, and whence a trip was made across Spencer's Gulf to the iron ore deposits at Iron Knob, whence the ore is now sent to the company's new ironworks at Newcastle, New South Wales. The party then proceeded to Broken Hill by special train, and spent a day in the examination of the underground and surface exposures of the famous lead-silver vein.

Another party visited the Cambrian glacial beds of the Sturt River and the Permo-Carboniferous tillites of Hallett's Cove, passing thence over the Upper Cambrian limestones, with Archæocyathus, of Sellick's Hill to the Inman Valley, where the striated surfaces underlying the Permo-Carboniferous tillites were first described by Stirling, and returned to Adelaide by way of the Mount Lofty Ranges.

At Melbourne, which was reached on August 13, the first meeting of the section was opened with an address by Prof. E. W. Skeats on the geology of Victoria, in which the general structure of the colony was described, particular attention being devoted to the areas covered by the official excursions. There followed a paper by Dr. T. S. Hall on Victorian graptolites, after which Prof. Johannes Walther exhibited and described a series of lantern slides in colour illustrating rock-disintegration by change of temperature and other phases of denudation characteristic of arid regions.

Prof. A. P. Coleman dealt with the climatic conditions of the Early pre-Cambrian. He referred to the desert conditions which are believed to have occurred during the Keweenawan or Torridonian period, and to the Ice age of the Huronian, and announced that recent work in Canada showed the action of water and a cool climate on the Sudbury series of pre-Laurentian age, and even in the still older Grenville and Keewatin series. "These are the earliest known formations, so that air and water worked in the usual way at the beginning of recorded geological time." Prof. Skeats read a paper on the Tertiary alkali rocks of Victoria, and Dr. H. S. Summers dealt with the origin and relationship of the same.

The morning of August 18 was devoted to a joint discussion with members of Section E on the physiography of arid lands, which was opened by Sir Thomas H. Holland, and continued by Sir Charles Lucas, Prof. W. M. Davis, Prof. J. W. Gregory, Prof. Albrecht Penck, Dr. Griffith Taylor, Mr. E. C. Andrews, Mr. A. L. Du Toit, Mr. Kenyon, Dr. W. F. Hume, Mr. H. T. Ferrar, Mr. D. M. S. Watson, and others.

The final day of the Melbourne meeting was devoted to the Tertiary deposits of south-eastern Australia. Papers on this subject were contributed by Mr. F. Chapman, Dr. T. S. Hall, Dr. G. B. Pritchard, Mr. R. Bullen Newton, Prof. J. W. Gregory, Mr. D. J. Mahony, and Mr. H. Herman, and were followed by a general discussion on the age and sequence of the strata.

The excursions during the Melbourne meeting included one to the area round Mount Macedon, where several exposures of alkali rocks, including anorthoclase trachyte, dacite, grano-diorite, and solvsbergite,

were examined, and another to the celebrated Bacchus Marsh district, where the chief points of interest were the Tertiary basaltic lava flows, the magnificent gorge of the Werribee River and the Permo-Carboniferous tillites which may be seen resting on grooved and striated surfaces of slate, sandstone, and quartzite of Ordovician age, the surfaces in some instances being as fresh as those of Pleistocene age in Britain.

Sydney was reached by rail on August 20, and here the sectional proceedings were opened by Sir Thomas H. Holland's presidential address, which will be found printed *in extenso* in NATURE of September 3, and was followed by an address on the geology of New South Wales, by Mr. E. F. Pittman. Other papers read during the Sydney session included Prof. T. W. Edgeworth David and Mr. W. S. Dunn on the Permo-Carboniferous fauna; Mr. E. C. Andrews, "The Post-Jurassic Geography of Australia"; papers on artesian water by Mr. E. F. Pittman and Mr. S. Dunstan; on metallogenetic provinces of Eastern Australia, by Mr. C. A. Sussmilch; on the genesis of the diamond in New South Wales, by Mr. L. A. Cotton; on spilitic lavas in New South Wales, by Mr. W. N. Benson; and on structural features of the coal-fields of Pennsylvania, by Prof. E. S. Moore.

The geological excursions from Sydney were (*a*) to the Blue Mountains and Jenolan Caves, and (*b*) to West Maitland and Newcastle. The Blue Mountains are capped by the sandstones of the Hawkesbury series (Trias), which rests on Permo-Carboniferous and Carboniferous rocks, which are exposed in many of the valleys, and in turn rest with marked unconformity on the Upper Devonian of Mount Lambie. The Jenolan Caves, which are excavated in limestones of Silurian age, are well known for their magnificent stalactites.

The Maitland district is chiefly of interest on account of its workable coals, and the occurrence of beds of tillite and other glacial beds in its Permo-Carboniferous series.

The section of the Permo-Carboniferous system is the most complete yet described in any part of Australia. The highest beds are those of the Newcastle series, which are of fresh-water origin, and contain some thirteen seams with a thickness of 3 ft. and upwards. These rest upon the Dempsey series, with Glossopteris and Gangamopteris, which in turn overlies the Middle or Tomago Coal Measures with several important seams.

The Upper Marine series which underlies the Tomago consists of cherts, shales, and calcareous sandstones, and rests upon the Greta Coal Measures, which contain two principal seams, the upper varying from 14 ft. to 32 ft. and the lower from 3 ft. to 11 ft. in thickness. Below the Greta Measures lies the Lower Marine series.

The glaciation appears to have taken place from a radiant point situated in a now submerged region between Tasmania and Kangaroo Island, south of Adelaide.

The members who went to Brisbane divided into several parties, some visiting the striking trachytic necks of the Glass House Mountains, while others investigated the geological structure and gold-mining industries of Gympie and Mount Morgan. The Trias-Jura coal-bearing beds of Ipswich, near Brisbane, were also visited. The beds are considerably folded and rather heavily faulted, and rest unconformably on the Gneissose rocks of Brisbane.

Excursions which had been arranged to New Zealand and Tasmania were abandoned on account of the war in Europe.

A. R. D.

EDUCATION AT THE BRITISH ASSOCIATION.

THE section met in Melbourne and Sydney. The programme had been carefully divided between the two cities, but as it was impracticable to divide the presidential address, the organising committee arranged to give special prominence to the address of Prof. Armstrong (vice-president), which was to be given in Melbourne. It was a strong plea for the further recognition of science in education and in the State, and extracts from it have already been published in NATURE (October 22, p. 213).

Following upon Prof. Armstrong's address Mr. C. A. Buckmaster read a paper on State aid to science. It was an interesting retrospect of official experience which it is scarcely possible to summarise here, though we may express the hope that the paper will shortly be published in full. Mr. W. D. Eggar discussed the position of mathematics and sciences in a liberal education. In his view the "mathematics required by university qualifying examinations is either too little or too much." From the point of view of use, it is only men in scientific professions who require more than plain arithmetic, and simultaneous quadratics is insufficient to produce æsthetic appreciation of the subject in the educated man. Instead of Euclid, which appealed to clever sixth-form boys, we have now a hotch-potch in which any proof of a theorem is accepted if it is good enough for an engineer. In science, again, everything is sacrificed to the stupid boy. Only the science which is useful is favoured. Astronomy, for example, is not usually taught at school. The problem of education after all is the opening of windows of the mind, and in the teaching of any subject we should concern ourselves with the question, How far must we go to come to a window? Cannot some agreement be arrived at as to the number and position of the windows which should be opened by a liberal education?

The second day at Melbourne was devoted to the subject of vocational education. Dr. C. W. Kimmins gave an account of the London trade schools, which are designed to bridge over the gap between fourteen and seventeen. In order to make them accessible to poor children, maintenance grants rising from 6*l.* to 15*l.* a year, and free education, are liberally provided by the County Council scholarship scheme. Definite trade instruction is also given in certain instances (tailoring and bakery), but scholarships are not awarded in these cases. The trade school has also become a necessity owing to the decay of the apprenticeship system, in comparison with which it has certain compensating advantages—it provides better supervision, it does not neglect literary subjects, it takes a completer view of the trade itself, and it provides a due balance of theory and practice. These schools have the further advantage that they are governed by a consultative committee of experts—a most important essential in their success. The cost of such schools in London works out at 15*l.* to 21*l.* a year for boys, and 15*l.* for girls. Dr. Moody described his experiences in the organisation of commercial education, and Dr. Findlay dealt with the compulsory education of youth. A new type of institution and a new type of teacher are essential. Youth needs social experience and vocational guidance as well as instruction. Little can be done until the State accepts the principle of partial control over wage-earning youth. Mr. A. D. Hall considered that all education should be vocational: only then shall we get a product fit for something, because it has been subjected to the discipline of purposeful work. He outlined a scheme of agricultural education, which

was a good deal criticised by Australian members as quite unsuited to their conditions. Mr. Frank Tate described the effort made in Victoria to redeem education from the charge of being too academic.

On the third day, the section discussed the training of teachers, in which Dr. Smyth, of the Melbourne Training College, Prof. Findlay, and Prof. Green took part. Papers were also read by Prof. Boyce Gibson on moral education; Mrs. Meredith, on domestic training in primary schools; and Miss Lilian Clarke, on the teaching of botany. All these papers aroused a good deal of interest, and excellent discussions followed.

Prof. Perry opened the Sydney meetings with his presidential address, which was published in full in NATURE of October 1. After the presidential address, the greatest local interest was roused by Prof. Netschajeff's paper on experimental pedagogics in Russia. It was chiefly devoted to a descriptive account of research work in the experimental school which he has founded in Petrograd under the auspices of the Ministry of Commerce. The work there is mainly directed to the investigation of the changes in the mental life of children as depending upon age, sex, and environment, as well as the determination of the best methods of teaching the various school subjects. The teachers' judgments upon individual children have also been the subject of psychological investigation. Work of this kind necessitates a threefold process. It begins in the laboratory itself, and passes thence to the school, coming finally to the laboratory again for discussion and further research. The body of workers attached to the school have also been engaged in simplifying and cheapening psychological apparatus. They have produced a cabinet of essentials at so reasonable a price that no fewer than 131 schools and teachers' societies in Russia have been supplied. Prof. Netschajeff presented a specimen collection of this apparatus to the education department of the University of Sydney.

Another day was devoted to the discussion of the problem of the university in its relation to State and school. Sir Harry Reichel made a strong plea for university freedom. The whole work and spirit of a university would be killed by anything like bureaucratic control. Mr. Board, Secretary for Education in the State of New South Wales, gave general support to this view. Prof. Green urged the need for greater freedom for the schools, which at present suffer from the relatively rigid requirements of university entrance. Intellectual keenness is commonly lost in the effort to meet the demands of matriculation examinations. Schools also have yet to learn that their function is not defined by the university but by the needs of the vast majority of their pupils who do not intend to enter the university at all. Dr. H. B. Gray read a paper on school training for public life, in which he pleaded for a more liberal treatment of science in the public school. Thus he would not give more than from one-quarter to one-sixth of school life to the classics. More geography, a thorough study of one modern language, and of English literature and history would then be possible, and science might get reasonable treatment. Socially, too, the public schools need reform. They suffer from narrowness of outlook, which may serve to produce rulers of inferior races but does not turn out men suited to play a great part in the newer democracies.

Prof. Mackie read a paper on the training of teachers, giving an account of the conditions in New South Wales. A discussion followed in which Prof. Findlay, Dr. Kimmins, and Prof. Green took part. All the speakers emphasised the need for greater attention being given to research and experiment in this sphere of practical work. Dr. Kimmins gave an interesting account of a London County Council scheme for an Imperial interchange of teachers—a plan which would enable Australian teachers to spend a year at home, at little cost to themselves, and with the great advantage of enabling them to learn something of their profession as practised in London.

The sectional meetings were uniformly well attended, though along with other sections it suffered considerably at the hands of the Press on account of the war. Many English visitors enjoyed the opportunity of visiting educational institutions in the various States. All were impressed by what they saw. Everywhere, and particularly in New South Wales and Victoria, we found evidence of a profound belief in education and a readiness to make sacrifices in its behalf. Over-centralisation is perhaps the greatest danger in both States—a danger which is at a minimum now owing to the personalities in actual control. We were all greatly indebted to the authorities for the descriptive literature provided, and no better statement of the general position of Australian education is to be desired than that written by Prof. Anderson in the handbook provided by the Commonwealth for the association.

RECENT ASPECTS OF MUTATION.[1]

IN recent years significant developments have taken place in connection with the study of mutations; indeed, these developments are so numerous that only a few of them can be mentioned now. The genus Œnothera has continued to be a storm-centre around which many controversies have raged, but of late a number of these questions appear to have been definitely settled. Among the recent developments may be mentioned first the authentication of *Œ. lamarckiana*, Ser., as an endemic species of the North American flora. The specimen collected by Michaux some time during his travels in eastern North America between the dates 1785 and 1796, which is now in the Muséum d'Histoire naturelle in Paris, and to which de Vries has recently directed attention, proves that this species did not originate in cultivation, as has been so frequently surmised. This shows also that it could not have come from Texas in 1860, as was stated, and it may yet be found in Kentucky or perhaps in western Virginia. This belief is founded on several considerations which I need not enter into here.

In order to show that *Œ. lamarckiana* differs in no respect from several other species as regards its history and fate, let me trace the history of certain of these species. *Œ. biennis*, L., as it now grows on the sand-dunes of Holland, where it has been naturalised since early in the eighteenth century, is identical with a form cultivated at Oxford by Morison about 1660, from Virginia. Yet this form is not now known to occur anywhere in North America, though search may yet reveal it in its native home. This *Œ. biennis* was probably the first Œnothera to be taken to Europe, in 1614. It has remained for three centuries unmodified in its new habitat, though Stomps has recently shown that it gives rise to two mutations, *cruciata* and *sulphurea*, the latter of which was already recognised as a distinct variety by Linnæus in 1737, as Bartlett has shown. Another race of *Œ. biennis*, obtained originally from the Madrid Botanical Garden, contains several aberrant forms parallel to the *lamarckiana* mutations, including one resembling *laevifolia*, and it also produces *Œ. biennis lata*.

[1] From a lecture delivered at the Marine Biological Laboratory, Woods Hole, Mass., on August 14, by Dr. R. Ruggles Gates.

The history of *Œ. parviflora*, L., is no less interesting. Morison grew it, and several early specimens are also found in the British Museum. Like *Œ. biennis*, it masqueraded under a pre-Linnæan polynomial. Unlike *biennis*, however, it does not seem to have become naturalised, in Europe, but it was preserved in botanic gardens until rediscovered by Miss N. M. Stevens in Maine in 1905, and described in full by MacDougal and Vail. *Œ. muricata* again was named by Linnæus, but had been introduced a century earlier, as shown by specimens in the Morison Herbarium.

Œ. angustissima has had a somewhat different history. I described this species from Ithaca, N.Y., last year, and afterwards found that Morison had cultivated a closely similar race of the same species. The latter probably came from Maryland, where I believe it still exists. Being a weaker species it has not only failed to become naturalised in Europe, but has long since disappeared from the botanic gardens.

It will thus be seen that the status of *Œ. lamarckiana* differs in no respect from that of other species, and experimental attempts to produce it by crossing two other species are bound to be futile. On the other hand, its open-pollinated habit allows of continual intercrossing of closely related races. But these races naturally occupied the same geographical area, and it is therefore useless to attempt, as has been done, to produce *lamarckiana* by crosses between two races or species which are geographically isolated from each other.

Another feature of *Œ. lamarckiana* which it shares with such species as *Œ. muricata* and *Œ. angustissima*, consists in the existence of several distinct races differing from each other in minor particulars. The Swedish race cultivated by Heribert-Nilsson differs from that of de Vries in a number of points, and resembles more closely the Œnotheras cultivated in English gardens. The latter also exhibit various racial differences in addition to the mutations. *Œ. lamarckiana* does not, therefore, consist of a single elementary species; and in this respect it resembles the majority of ordinary wild species. How these racial differences have originated is another question, but they are of a different order from the differences between the mutations. They exhibit one kind of diversity, the mutations another. In other words, there are here two kinds of polymorphism, and they should not be confused with each other.

The discovery that *Œ. lamarckiana* is an endemic North American species not only dispels the hypothesis that it might have originated in cultivation, but considerably weakens the Mendelian assumption that the mutants are merely hybrid combinations, and the mutation process a phenomenon of hybridisation. Since Bateson's original suggestion to this effect in 1902 nearly all the Mendelians have taken a turn at explaining the mutations in this way. We have heard of coupling of characters, duplication of gametes, and innumerable other hypotheses of this kind applied to the peculiarities of Œnothera. But it has long been obvious to critical students of Œnothera that although *Œ. lamarckiana* may be in some limited sense a hybrid, yet the mutation phenomena themselves come in a different category. And it has remained for the Mendelian assumption to be totally disproved by other lines of attack on the problem.

The analytical breeding experiments show that something other than Mendelism has to be dealt with in Œnothera, while the cytological work furnishes certain definite clues concerning the nature of the germinal changes involved. The evidence from every hand is so overwhelming that it can no longer be doubted that mutation is a phenomenon of variation, and not merely of inheritance, as Mendelians would have us believe.

It may perhaps be pointed out here that Mendelism is itself a theory merely of heredity, and a partial theory at that, dealing only with complete or discontinuous inheritance. The manner of origin of these inherited differences is a matter on which Mendelians have speculated much, and we have had complete evolutionary philosophies founded on the presence-absence hypothesis and the supposed universal "loss of factors" in the origin of *nova*. But it is obvious that a theory of inheritance, or even a knowledge of inheritance, does not necessarily throw any light on the *origin* of the differences the inheritance of which is considered. In point of fact, instances may be cited in which a character, the evolutionary development of which was very gradual, has been suddenly lost through a germinal change. It is then inherited in a discontinuous way in crosses with the "loss-mutation." The hornless condition in cattle is a case in point. To suppose that because a character is inherited in discontinuous fashion it has *necessarily* originated in a similar manner may therefore lead to wholly erroneous conclusions.

Experiment shows it to be equally untrue, conversely, that when a new feature originates suddenly it must always be inherited in Mendelian or alternative fashion. It *may* be alternative, or it may give a permanently blended result, depending in part upon the organism with which it is crossed.

An example of this kind of behaviour has occurred in breeding experiments with *Œ.* mut. *rubricalyx*. This form originated as a heterozygous mutation from *rubrinervis*, its offspring splitting into *rubricalyx* and *rubrinervis* in a simple 3 : 1 ratio, the red pigmentaton of *rubricalyx* being dominant. Extensive crosses have been made between *rubricalyx* and *Œ. grandiflora*, Solander. The latter species differs throughout from *Œ. lamarckiana* and its derivatives. The most striking differences are in foliage, buds, pubescence, and physiological reactions, *Œ. grandiflora* developing more rapidly at certain stages, and being adapted to a more southern climate.

In *grandiflora* × *rubricalyx* and its reciprocal, the F_1 hybrids are intermediate in foliage and other features, but the *rubricalyx* pigmentation is essentially dominant, though the depth of red is paler than in the *rubricalyx* parent. When the *rubricalyx* parent was heterozygous for the red (R) the F_1 contained, as anticipated, 50 per cent. with red buds (R) and 50 per cent. with green buds (*r*). In the F_2 families sharp segregation usually took place, but a few rare cases were found in which the red pigmentation had not behaved as an unmodified unit-factor, but was intermediate, *i.e.* the sepals were paler red with only traces of red on the hypanthium. By selfing such individuals it was found that a new and intermediate condition of pigmentation had been obtained, for the F_3 offspring bred true to the condition of their parent. In this way a sharp unit-character which has originated through a mutation may be permanently modified by crossing with another species.

By back-crossing the ordinary F_2 offspring again with *grandiflora* the pigmentation is also further diluted, and new conditions of stability in pigmentation are reached. Many of the details of these experiments have already been published, and here attention is merely directed to the fact that the Mendelian 3 : 1 ratio with sharp alternation between the characters appears to depend upon a condition of balance in the organism. If this condition of balance is disturbed by crossing with another species having a different metabolism then the character in question may be

modified, diluted, and blended, even though it originally appeared sharply and suddenly through a mutation in the race.

Returning to the previous line of argument, it should therefore be obvious that no theory of heredity, either Mendelism or any other, is adequate to account for the *origin* of characters, and Mendelians are responsible for much confusion of thought in failing to observe the fundamental distinction between the origin of a character and its subsequent inheritance. It is the *origin* of the character, the nature of the change involved in its appearance, and the manner and causes of its apparition, with which mutationists are primarily concerned.

It is, therefore, only after analysing many actual cases of mutation, and determining the nature and causes of the germinal changes involved in each, that generalisations can be made regarding the nature and significance of the mutation process. This has been done most completely in Œnothera among plants, and by the experiments of Morgan and his students with Drosophila among animals. Without drawing comparisons between the two series of observations and experiments, which differ in many features, reference may be made to a few of the points of view to which the work with Œnothera has led.

In the first place, as already pointed out, it has become clear and indisputable that mutation is a phenomenon of variability and not merely of inheritance. The breeding experiments and the cytological investigations have co-operated in proving this thesis, and thus eliminating the swarm of Mendelian hypotheses. In the second place, we now know that mutation, at least in Œnothera, is a composite process. Each mutation is in a new direction, and represents a different kind of germinal change. It is quite erroneous to suppose, as Heribert-Nilsson has done, that the various mutations of Œnothera fall into plus and minus series. Any such classification is of the most superficial kind, and the cytological investigation of the various mutants has done more than anything else to throw light upon the real nature of the change involved in each case.

It may be worth while to observe here that the multifarious nature of mutations, representing as they do departures in many directions from the parent stock, is in harmony with present conceptions of certain general features of animal phylogeny, according to which many lines of divergence appear to have departed simultaneously from a common stock. On the other hand, orthogenetic phylogenies, of which there appear to be many examples in the palæontological record, must depend upon other principles which are not here considered.

When we analyse cytologically the different mutants of Œnothera they are seen to fall into at least four or five categories. We may mention :—

1. Duplication of a single chromosome to give 15.
2. Hypothetically, in a case soon to be published, a second duplication, to give 16 chromosomes.
3. Triplication of the whole gametophyte series of chromosomes, giving 21.
4. Duplication of the whole sporophyte series, giving 28 chromosomes.
5. The large class of mutations in which no change in chromosome number occurs.

The latter will be referred to again later. They really include many diverse types of change, and only agree in not having a visible structural change in the nucleus.

The peculiarities of the mutants *lata* and *semilata* are constantly associated with the presence of fifteen chromosomes instead of fourteen. In 1908 the meiotic irregularity which leads to the formation of a germ cell, and later an individual, having an extra chromosome was first observed. The same unequal chromosome distribution has since been observed in several derivatives of *Œ. lamarckiana*, and also in wild *Œ. biennis* from Woods Hole, showing that these are all capable of producing *lata* mutations. It seems obvious that the mutation occurs when a chromosome passes into the wrong germ cell in meiosis, and that the peculiarities in foliage and habit exhibited by *lata* and *semilata* result from the fact that all the nuclei of the plant contain a complex of fifteen instead of fourteen chromosomes. The extra chromosome is, evidently from its origin, a triplicate of a pair already present in other forms, and apparently any member of the seven pairs may become the extra chromosome. The obvious resemblances and differences between this and the accessory or sex chromosomes need not be considered here.

The phenomenon of tetraploidy, now known to be exhibited by many species of plants and animals, first derived evolutionary significance from the fact that *Œ.* mut. *gigas*, which de Vries found to originate suddenly from *Œ. lamarckiana*, is tetraploid, having twenty-eight chromosomes. The tetraploid species of Hieracium, Antennaria, Drosera, Viola, Gyrostachys, Potentilla, and many other genera have obviously originated in a similar manner, and in the phylogeny of some families this doubling has occurred two or three times successively, so that the process is one of much evolutionary interest. The precise manner in which the doubling of the chromosome series occurs is not yet entirely clear, but it is obviously a different process from the duplication of one chromosome which gives rise to *lata*.

In the majority of mutations there is no obvious morphological change in the cell, and it appears that in such cases the ultimate change is chemical. These mutations fall into several categories differing in their hereditary behaviour. Although this matter is too involved to consider in detail here, reference may be made to what appears to be the probable basis of mutations which exhibit simple Mendelian behaviour when crossed with their parent race. We may take as an example the case of *Œ.* mut. *rubricalyx*, which originated from *rubrinervis* in cultures in 1907, and has never occurred before or since so far as known. The original mutant was heterozygous, its offspring yielding *rubricalyx* and *rubrinervis* in the ratio of 3 : 1. A homozygous race has since been obtained.

The origin of such a mutant can be adequately explained on the assumption that the substance of a single chromosome underwent a chemical change of such character that the activities of the chromosome in the whole complex of the cell led to the production of quantities of anthocyanin where it had not been produced before or where it had been produced only in small amounts. Of course, this change may be confined to one portion of a chromosome, and does not necessarily affect the whole body of the chromosome. The behaviour of mutations which exhibit a simple dominant or recessive unit-difference is fully accounted for by this hypothesis. It may be said that this merely assigns the phenomenon to the chromosomes without further analysing it. But such hypothetical changes in chromosomes are strictly analogous to the mutations which many bacteria are now known to undergo, and if such simple organisms as bacteria can experience sudden changes in structure and function it is in no way improbable that chromosomes can do likewise.

We may even explain in this way the origin of "duplicate genes," such as have been described by Nilsson-Ehle in wheat. In some families he obtained a ratio of approximately 15 : 1 for red, and absence of red in the glumes; in other families the ratio 3 : 1 was obtained. It appears that in the former case two

independent "determiners for red" are present in the germ cells. This condition receives a reasonable explanation if we assume that two chromosomes, belonging to different pairs, have each undergone the change which leads to the production of red in the glumes.

It would take us too far to attempt to analyse the various other types of mutations which are now known to occur, but we may refer to one other case. The origin of *Œ.* mut. *nanella* cannot be explained in the same way as that of *Œ.* mut. *rubricalyx*, for its hereditary behaviour is different. Not only is *nanella* recessive in comparison with *rubricalyx*, which is dominant, but when we cross *lamarckiana* with *nanella* we obtain both parent forms in F_1, and both afterwards breed true. If the behaviour were Mendelian, the dwarfs should appear first in the F_2. On the other hand, *rubrinervis* × *nanella* produces *lamarckiana* and *rubrinervis* only in the F_1, and *nanella* in the F_2. The only explanation of this behaviour that has been offered is de Vries's hypothesis of labile pangens. However we picture the change from *lamarckiana* to *nanella*, it has happened differently from the mutations previously mentioned, and de Vries's supposition that splitting in such cases occurs in F_1 or F_2 according to whether the character is present in the labile or stable condition is the only hypothesis that meets the case.

From the instances already mentioned it will be seen that mutation is a multifarious process, and the greatest need of the present time is the analysis of many individual cases through combined cytological and experimental study. Such analyses will lead to a better understanding of the nature of germinal changes and the way in which they contribute to evolutionary progress. The study of inheritance, Mendelian or otherwise, is useful and entertaining, but behind it lies the question as to how and why Mendelian and other differences arise. We have seen that a bewildering variety of germinal changes occurs, and their study opens a vast field of investigation which has scarcely as yet been touched upon. When we know more of the nature of germinal changes and the laws and causes of their occurrence it should be possible to apply the knowledge more directly to problems of phylogeny.

To me, the most significant distinction between mutations and fluctuations, or germinal changes and continuous variations, lies in the fact that the former are inherited as wholes, though it may be only in a fraction of the offspring; while the latter are partially inherited and are also more amenable to the environment. Darwin relied chiefly upon what we call continuous variations, because the complete inheritance of "single variations" or mutations was then unknown. It does not follow, however, that the latter furnish the whole of the material for evolution, and I am inclined to believe in a large borderland between these two categories of variations, which is at present unexplored.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE London County Council has arranged for a series of five lectures entitled "The Natural History of Some Common Animals," to be given at the Horniman Museum, Forest Hill, on Wednesday evenings, at 8 p.m., commencing yesterday. The lectures will be illustrated by lantern slides and specimens; each will be complete in itself, and there will be no charge for admission.

WE have received from the University of Sydney a copy of an interesting publication entitled "Bibliographical Record of the University of Sydney, 1851–1913." It is chiefly composed of lists of the publications of the members of the University staff, and of its research scholars. The titles of original papers in the various subjects of university study, and of treatises and text-books published from time to time, run to eighty-four closely printed pages, and form excellent testimony to the ability and industry of the members of the University and to the value of their contributions to our knowledge.

WE are informed that the 1914–15 session of Hongkong University commenced on September 14 with a good entry of students; eight entered from the province of Chihli and several from the Straits, Shanghai, etc. Since the last session the staff has also increased, the latest addition being Mr. W. Brown, a lecturer in mechanical engineering. There are now seventy-six students in the university studying engineering, and the British staff in the engineering faculty consists of the Taikoo professor, five lecturers and an electrician. Numerous visitors are attracted by the magnificent equipment presented by British manufacturers.

A SUPPLEMENT to the original "Catalogue of Books on the Useful Arts" in the central libraries of Newcastle-upon-Tyne, which was published in 1903, has been prepared by Mr. Basil Anderton, the public librarian, and issued by the Public Libraries Committee. The present catalogue covers the accessions to the library during the years 1903–14 and includes the titles of volumes in the lending libraries as well as those in the central reference library. Dewey's decimal classification is adopted, and the index will guide readers straight to the group of books they desire. Mr. Anderton and his staff may be congratulated not only upon the excellence and completeness of their catalogues, but also upon the comprehensive collection of technical literature which they have been enabled to provide for the use of students in their area.

THE issue of *Science* for October 23 contains the following announcements of bequests and gifts in aid of higher education in the United States. Phillips Academy, Andover, Mass., receives a bequest of about 92,400*l.* under the will of the late Mr. Melville C. Day, of New York, who died in Florence, Italy. This amount is the residue of the estate. At the termination of a life estate created for the benefit of a friend, Phillips Academy will receive a further sum of about 9000*l.* The late Mr. F. W. Dohrmann, for a number of years a regent of the University of California, has bequeathed 1000*l.* as a loan fund, for loans to members of the faculty to tide them over times of illness or other emergency. Miss Ellen B. Scripps has made a gift of 7000*l.* (in addition to 12,000*l.* previously subscribed by herself) for a pier, pumping plant, and additional equipment for the Scripps Institution for Biological Research, at La Jolla, near San Diego, California. For its maintenance she gives 2000*l.* yearly to the University of California.

A CERTAIN number of Belgian professors are now assembled at Cambridge, as well as an increasing number of students from Louvain, Liège, Ghent, and Brussels. In view of the appeal issued by the Belgian Government for volunteers, it has been decided in consultation with the Belgian Government, that only such students as are physically unfit for military service, or have been rejected for other reasons by the Belgian authorities, and are in possession of a certificate to that effect, can be accepted by the Cambridge hospitality and academic committees. It has proved impossible for Louvain University to transfer its corporate and official existence to Cambridge, and conse-

quently no attempt is to be made to organise official courses of study, to institute examinations, or to grant diplomas. But an endeavour is being made to combine systematic instruction on the lines of the Belgian universities with the requirements of refugee students and the possibilities of an incomplete Belgian teaching staff. The faculties of philosophy and letters, law, and engineering are so far most favourably placed. All students making application are asked to give their name, faculty, and university, and to state whether they require hospitality or can contribute to their maintenance. All applications should be sent to Mr. J. T. Sheppard, King's College, honorary secretary of the general committee, or to Mr. E. Bullough, Gonville and Caius College, honorary secretary of the academic committee.

THE November issue of the *British Review* includes an article by Mr. J. G. Vance, on the University of Louvain. The University was founded in 1425, but as it was before the arrival of the invading Germans in Louvain, it had known only eighty years of life. Mr. Vance traces its varying fortunes from its foundation until the beginning of the nineteenth century; but the most interesting and illuminating part of his essay is his sympathetic account of the part the University has taken in the national life of Belgium in recent times. In 1834 the undergraduates numbered only eighty-six; after twenty-four years of vigorous life, there were fewer than 800; in 1855, about 1700; in 1909, about 2300; while within the last year the total has run up to 3000. Yet Belgium, with a total population of some seven millions, has four universities. No subsidy or grant of any kind has ever been received by the University from the State, the province, or the commune. The University is maintained entirely by the devotion and sacrifice of Belgian Catholics. "Rich and poor have contributed now for some eighty years to build up the University, which has been a common charge and a common burden. Every priest holding any position in any of the six Belgian dioceses pays an annual university tax, varying according to his rank and means, from five to a hundred francs. In every Catholic chapel and parish church there are two collections every year on behalf of the university, which is known to every Catholic, whether he be farm-labourer or barrister, as 'alma mater.' Lastly, a house-to-house visitation is made once a year by the curé of all the parishes, with a view of collecting and encouraging subscriptions for the same purpose."

A COPY of the calendar for the current session of the University of Sheffield has been received. It gives full particulars of courses of instruction provided in the various faculties in preparation for the degrees and diplomas of the University. In common with our other modern universities, the University of Sheffield has a flourishing faculty of applied science in which degrees of bachelor, master, and doctor of engineering and metallurgy are conferred under the conditions specified in the calendar. A bachelor of engineering degree in mining has also been instituted. For students who for various reasons do not find it convenient to graduate, courses for associateships in the faculty of applied science have been arranged. Among numerous other arrangements made to meet the needs of the community served by the University may be mentioned a two years' course of work in the University and the Sheffield Training College of Domestic Science. The scientific portion of the work is taken at the University, and the technical studies in cookery, laundry, and housewifery at the training college. The calendar also gives details of a comprehensive scheme of University extension work designed to provide the means of higher education for persons who are engaged in the regular occupations of daily life. The University is also able to offer for competition a generous supply of scholarships, fellowships, exhibitions, and prizes. The arrangements in the more ordinary faculties comprised in University work are very complete and compare favourably with those of other institutions of higher learning.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 5.—Sir William Crookes, president, in the chair.—Sir William **Crookes**: Acquired radio-activity. Various objects, diamond, ruby, garnet, quartz, gold, platinum, etc., also the phosphorescent substances yttria, calcium sulphide, zinc blende, and barium platinocyanide, are bombarded in a high vacuum by kathode rays, and in no case can any permanent activity be recognised either by photographic or electrical means. Exposure to radium emanation confers temporary radio-activity on all bodies that have been tried, apparently due to the condensation of the emanation on the surface. This transient activity can be completely removed by washing in dilute acids. Many substances become coloured by direct exposure to radium, the colour depending on the substance. Diamond takes a full sage-green tint, the depth of tint depending on the time of exposure to the radium. In addition to change of colour, diamond also becomes persistently radio-active, continuously giving off α, β, and γ rays. The acquired colour and activity withstand the action of powerful chemical agents, and continue for years with apparently undiminished activity. Removing the surface by mechanical means removes both colour and radio-activity. The appearance of an auto-radiograph made by placing an active diamond crystal on a sensitive photographic plate, and the visual examination of its "scintillation" luminosity, suggest that there is a special discharge of energy from the corners and points of the crystal.—Hon. R. J. **Strutt**: Luminous vapours distilled from the arc, with applications to the study of spectrum series and their origin. II. (1) The conducting properties of a luminous jet of mercury vapour distilled from the arc *in vacuo* have been examined. The current depends on the shape and position of the kathode introduced into the jet, and is independent of the position of the anode. In the case where the anode is reached first by the stream of vapour, and a net electrode is used as kathode, all the positive ions may be taken out of the vapour that passes through the kathode. (2) The luminosity of the jet is unaffected by the removal of negative ions at the anode, but is quenched by removal of positive ions at the kathode. Although the removal of negative ions in the latter case is not complete, it is considerable enough to show conclusively that the luminosity is independent of the number of negative ions present. Thus the luminosity is not due to recombination of ions. (3) Experimenting with other metals as well as mercury, it is found that the various lines of a spectrum are not, in all cases, equally extinguished when the jet of luminous vapour passes through a negatively electrified net. Thus the lines of the subordinate series of the sodium spectrum apparently all lose intensity in the same ratio; but the D line of the principal series is much less affected. (4) The jets formed by arsenic and antimony, which show band spectra consisting of large numbers of uniformly spaced bands, are not quenched by passing through a negatively electrified net. The luminous centres appear therefore to be uncharged in these cases.—Prof. J. N. **Collie**, H. S. **Patterson**, and I. **Masson**: The production of neon and helium by the electrical dis-

charge.—Prof. C. H. **Lees**: The flow of viscous fluids through smooth circular pipes.—F. O. **Rice**: Quantitative measurements of the absorption of light. I.—The molecular extinctions of the saturated aliphatic ketones. The absorptive power of fourteen of the saturated aliphatic ketones has been measured quantitatively with an ultra-violet spectro-photometer. It was found that previous observations by other authors were inaccurate owing to the presence of impurities in the ketones. The general results of the present observations are considered from two points of view, namely, the position of the absorption band and the maximum absorptive power. The wave-length of the absorption band depends upon the number and position of the alkyl groups in the side-chain, and tends to increase with the number of CH_3 or CH_2 groups.—Prof. W. M. **Thornton**: The ignition of gases by condenser discharge sparks.—E. G. **Bilham**: The spark spectrum of nickel under moderate pressures.

CAMBRIDGE.

Philosophical Society, October 26.—Dr. Shipley, president, in the chair.—H. H. **Paine** and G. T. R. **Evans**: The conductivity of extremely dilute acid and alkali solutions.—N. **Wiener**: Studies in synthetic logic.

PARIS.

Academy of Sciences, October 27.—M. P. Appell in the chair.—Gaston **Darboux**: Partial differential equations of the second order with two independent variables and the relations of Laplace formed with such equations.—André **Blondel**: The theory of alternators.—M. **Coggia**: Observation of Lunt's comet 1914*b* made at the Marseilles Observatory. Position given for October 21.—M. **Bigourdan** communicated a telegram received from Comas Solà, director of the Fabra Observatory at Barcelona, giving the positions of a comet, possibly Encke's comet.—B. **Berloty**: Observation of the solar eclipse of August 21, 1914, at Ksara.

NEW SOUTH WALES.

Linnean Society, July 29.—Mr. C. Hedley, vice-president, in the chair.—E. F. **Hallmann**: A revision of the Monaxonid species described as new in Lendenfeld's "Catalogue of the Sponges in the Australian Museum." Part ii. The second part of the revision deals with the species (twenty-four in number) assigned by Lendenfeld to the families Homorrhaphidæ and Heterorrhaphidæ. Of these, five have not been identified; the remainder have been redescribed and figured. With few exceptions, the original descriptions have been found to be inaccurate and misleading, a number of them even confusing the external features of one species and the internal features of another; and, in the case of two of the species, the figures given are those of sponges not described in the catalogue at all.—J. H. **Maiden**: Further notes on the botany of Lord Howe Island. Part v. A description of a species of Plantago deemed to be new is offered. The paper contains notes on the vegetation of the summit of Mt. Gower by Mr. Hedley, who, and also Mr. W. S. Dun, placed his collections at the disposal of the author. Notes on the vegetation of the Admiralty Islets are given, together with critical observations on some introduced and other plants, the occurrence of which on the island was hitherto considered to be uncertain. Some notes on synonymy are included.—E. **Breakwell**: A study of the leaf-anatomy of some native species of the genus Andropogon (N.O. Gramineæ). Plants representative of seven species have been examined. In respect of anatomical structure, these fall into three groups.

August 26.—Mr. W. S. Dun, president, in the chair.—E. F. **Hallmann**: A revision of the Monaxonid species described as new in Lendenfeld's "Catalogue of the Sponges in the Australian Museum." Part iii. The concluding part of the revision deals with the families Desmacidonidæ and Axinellidæ. Several of the species described are new—among these being *Histoderma actinioides* and *Raspailia agminata*, examples of which are figured in the catalogue erroneously, in illustration of *Stylotella polymastia* and *Halichondria rubra* respectively.—F. H. **Taylor**: The Culicidæ of Australia. Part i. Seven species, referable to six six genera—Stegomyia (1), Ædimorphus (1), Culicada (2), Culex (1), Skusea (1), and Menolepis? (1)—are proposed as new, together with one variety. Additional records, for a number of previously known species, are included.—W. N. **Benson**: Petrological notes on various New South Wales rocks. The paper describes briefly collections made in various parts of New South Wales. Nullum Mountain, near Murwillumbah, consists of granophyre intrusive into Palæozoic schists. It is associated with dykes of trachyandesite, and a rock composed almost entirely of andesine. A well-known basalt-dyke at Gerringong contains abundant inclusions of alkali-felspar gneiss, granodiorite-gneiss, quartz-schist, and a few inclusions of gabbro. Interesting reactions occur between the xenoliths and basalt. Granitic inclusions are recorded from the volcanic necks of Dundas and Norton's Basin. The peculiar, green, fibrous decomposition-product of olivine, that occurs in the basic xenoliths of Dundas, and in the majority of the olivine-basalts of the Sydney district, is recognised as bowlingite.

BOOKS RECEIVED.

Water Supplies: their Purification, Filtration, and Sterilisation. By Drs. S. and E. K. Rideal. Pp. ix+274. (London: Crosby Lockwood and Son.) 7*s*. 6*d*. net.

Royal Observatory, Hong Kong. Report on the Time Service. Pp. 19. (Hong Kong.)

A First Book in Psychology. By Prof. M. W. Calkins. Fourth edition. Pp. xxi+428. (London: Macmillan and Co., Ltd.) 7*s*. net.

English Humour in Phonetic Transcript. By G. Nöel-Armfield. Pp. xv+73. (Cambridge: W. Heffer and Sons, Ltd.) 1*s*. 3*d*.

Transactions of the Paisley Philosophical Institution, 1914. The Abbey Hazel Nuts: their Geological and Historical Significance. By Rev. C. A. Hall and D. Smith. Pp. 31. (Paisley: A. Gardner.) 6*d*.

City and County of Newcastle-upon-Tyne. Public Libraries Committee. Catalogue of Books on the Useful Arts in the Central Libraries, 1903–14. Edited by B. Anderton. Pp. viii+209. (Newcastle-upon-Tyne: Public Library.)

Technical Gas Analysis. By Dr. G. Lunge. Pp. xv+407. (London: Gurney and Jackson.) 15*s*. net.

Technical Methods of Chemical Analysis. Edited by Dr. G. Lunge and collaborators. English translation edited by Dr. C. A. Keane and collaborators. Vol. iii., part 1. Pp. xxxi+538. Vol. iii., part 2. Pp. xv+539–1125. (London: Gurney and Jackson.) 3*l*. 3*s*.

The Whip of God. By R. H. McCartney. Pp. 30. (New York: C. C. Cook.)

Catalogue of Coins in the Colombo Museum. Part i. Muhammadan and European (exclusive of Roman). By H. W. Codrington. Pp. 61. (Ceylon.)

Bibliographical Record of the University of Sydney. 1851–1913. Pp. 94. (Sydney: The University.)

Ministry of Finance. Egypt. Survey Department. Meteorological Report for the Year 1912. Pp. xxii+237. (Cairo: Government Press.) P.T. 30.

Meteorology of Australia. Commonwealth Bureau of Meteorology. Vol ii. Nos. 2 to 13. (Melbourne: A. J. Mullett.)

The Story of Yone Noguchi. Told by Himself. Pp. xi+255. (London: Chatto and Windus.) 6s. net.

Reason and Belief. By Sir Oliver Lodge. Third edition. Pp. xii+212. (London: Methuen and Co., Ltd.) 1s. net.

A History of British Mammals. Part xvi. (London: Gurney and Jackson.) 2s. 6d. net.

Jute and Linen Weaving. By T. Woodhouse and T. Milne. Second edition. Pp. xxvii+590. (London: Macmillan and Co., Ltd.) 12s. net.

A Class-Book of Commercial Knowledge. By E. J. Balley. Pp. viii+125. (London: G. Bell and Sons, Ltd.) 1s. 6d.

The Manufacture of Organic Dyestuffs, by Prof. A. Wahl. Translated by F. W. Atack. Pp. xiv+338. (London: G. Bell and Sons, Ltd.) 5s. net.

Great Colliery Explosions and their Means of Prevention. By Dr. W. Galloway. Pp. 130. (London: *Colliery Guardian* Co., Ltd.)

Crystallography: an Outline of the Geometrical Properties of Crystals. By Prof. T. L. Walker. Pp. xiv+204. (New York: McGraw-Hill Book Co., Inc.; London: Hill Publishing Co., Ltd.) 8s. 4d. net.

The Raw Materials for the Enamel Industry and their Technical Technology. By Dr. J. Grünwald. Translated by Dr. H. H. Hodgson. Pp. viii+225. (London: C. Griffin and Co., Ltd.) 8s. 6d. net.

The "Wellcome" Photographic Record and Diary, 1915. Pp. 280. (London: Burroughs Wellcome and Co.) 1s.

Geology of To-day. By Prof. J. W. Gregory. Pp. 238. (London: Seeley, Service and Co., Ltd) 5s. net.

Supplement to the Indian Journal of Medical Research. Proceedings of the Third All-India Sanitary Conference, held at Lucknow, January 19 to 27, 1914. Vol. ii., Papers. Vol. iii., Papers. Vol. iv., Papers. Vol. v., Papers. (Calcutta: Thacker, Spink and Co.)

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 12.

ROYAL SOCIETY, at 4.30.—Analyses of Agricultural Yield. I.: Spacing Experiments with Egyptian Cotton: W. L. Balls and F. S. Holton.—The Fixation of Arsenic by the Brain after Intravenous Injections of Salvarsan: J. McIntosh and P. Fildes.—The Production of Anthocyanins and Anthocyanidins. II.: A. E. Everest.—Living Observations on the Life Cycle of a New Flagellate—*Helkesimastix faecicola*, together with Remarks on the Question of Syngamy in the Trypanosomes: H. M. Woodcock and G. Lapage.—The Antagonistic Action of Carbon Dioxide and Adrenalin on the Heart: S. W. Patterson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Cables: C. J. Beaver.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting. Presidential Address: Mathematical Research; Prof. Love.

FRIDAY, NOVEMBER 13.

ALCHEMICAL SOCIETY, at 8.15.—The Movement of Alchemical Research in France: Actual Traces of Transmutation: W. de Kerlor.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A Class of Asymptotic Orbits in the Problem of Three Bodies: A. H. Warren.—The Proper Motions of the Stars in Carrington's Circumpolar Catalogue in Relation to their Spectral Types: F. W. Dyson.—The Stability of Direct and Retrograde Satellite Orbits: F. R. Moulton.—An Efficient Slow Motion Gear: W. S. Franks.—Partial Eclipse of the Sun, 1914, August 21, Observed at Armagh: J. L. E. Dreyer.—(1) Note on the Franklin-Adams Chart. (2) Natural Sines and Cosines in R.A.: O. R. Walkey.—The Determination of Fundamental Photographic Magnitudes: J. Halm.—Observations made during the Partial Eclipse of the Sun, 1914, August 21, at the University Observatory, Warsaw: S. Tscherny.—Note on the Nebular line λ3729: W. H. Wright.—The Partial Eclipse of the Sun, 1914, August 21, Observed at South Kensington: A. Fowler.—Note on the Meaning of the So-called Third Star Stream, Drift O: H. H. Turner.—Mean Areas and Heliographic Latitudes of Sun-spots in the Year 1913: Royal Observatory, Greenwich.—*Probable Papers:* The Temperature Coefficients of Edinburgh Transit Circle: R. A. Sampson.—The Best Geographical Site for a Solar Observatory: J. Evershed.—Observations of the Transit of Mercury, 1914, November 5: Royal Observatory, Greenwich.—(1) The Absorption of Light in Space. (2) Account of the Eclipse Expedition to Minsk: H. S. Jones.

PHYSICAL SOCIETY, at 8.—A Bridge for the Measurement of Self-Induction: D. Owen.—The Coefficient of Diffusion in Dilute Solutions: B. W. Clack.

TUESDAY, NOVEMBER 17.

INSTITUTION OF CIVIL ENGINEERS at 8.—Economics of Electric Railway Distribution: Dr. H. F. Parshall.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Stone Implements from Gravel Beds in South Africa, with Notes: R. A. Smith.—The Prehistoric Pottery of the Canary Islands: Hon. J. Abercrombie.

WEDNESDAY, NOVEMBER 18.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Isomeric Rainfall Maps of the British Isles: Dr. H. R. Mill and C. Salter.—A See-Saw of Temperature between England and Egypt: J. I. Craig.

ENTOMOLOGICAL SOCIETY, at 8.—New Mymaridæ from Tasmania: C. O. Waterhouse.

GEOLOGICAL SOCIETY, at 8.—A Raised Beach on the South Coast of Jersey: Dr. A. Dunlop.—Tachylite Veins and Assimilation Phenomena in the Granite of Parijs (Orange Free State): Prof. S. J. Shand.

THURSDAY, NOVEMBER 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Note on the Circulation of the Atmosphere: A. Mallock.—The Origin of the Indo-Gangetic Trough—commonly called the Himalayan Foredeep: Sir S. Burrard.—Approximately Permanent Electronic Orbits and the Origin of Spectral Series: G. W. Walker.—Spectroscopic Investigations in connexion with the Active Modification of Nitrogen. IV.: A Band Spectrum of Boron Nitride: W. Jevons.—An Additional Note on the Production of High Permeability in Iron: Prof. E. Wilson.

CHILD STUDY SOCIETY, at 7.30.—Development of the Practical Imagination in Children: Prof. T. P. Nunn.

LINNEAN SOCIETY, at 8.—*Hydrilla verticillata*, Caspary, a New British Plant: A. J. Wilmott.—The Mosses and Hepaticæ of West Falkland Islands, from the Collections of Mrs. Rupert Vallentin: C. H. Wright.—The Thysanoptera of the West Indies: R. S. Bagnall.

FRIDAY, NOVEMBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Effect of Vacuum on Steam-Turbines: G. G. Stoney.

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

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